Study Plan

For Year 3 of the Constituents of Emerging Concern Pilot Study

Version 1.1
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Prepared By:

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS

ACRONYM	DEFINITION
CEC	Contaminant(s) of emerging concern
CEDEN	California Environmental Data Exchange Network
Delta RMP	Delta Regional Monitoring Program
EPA	U.S. Environmental Protection Agency
QAPP	Quality Assurance Project Plan
SCCWRP	Southern California Coastal Water Research Project
SWAMP	State Water Resources Control Board's Surface Water Ambient Monitoring Program
TAC	Technical Advisory Committee

LIST OF UNITS

cfs	cubic feet per second
L	liter
m	meter
mg	milligram
mL	milliliter
ng	nanogram

INTRODUCTION

This “Year 3 Study Plan” for constituents of emerging concern (CEC) in the Central Valley provides background information and technical monitoring strategies and specifications. The Delta Regional Monitoring Program (Delta RMP) can use this Year 3 Study Plan to develop a Quality Assurance Project Plan (QAPP) and then implement the third year of this monitoring program.

BACKGROUND

A stakeholder group developed the Central Valley Pilot Study for Monitoring CECs Work Plan (**Appendix A**, referred to here as the Stakeholder Work Plan) outside of the Delta RMP. The stakeholder group consisted of several Delta RMP participants including publicly owned treatment works (POTW), municipal separate storm sewer systems (MS4s), the Central Valley Regional Water Quality Control Board (Regional Water Board), and the State Water Resources Control Board (State Water Board). The Delta RMP Technical Advisory Committee (TAC) under the previous governance structure reviewed and provided comments on the Stakeholder Work Plan.

The Delta RMP is implementing the Stakeholder Work Plan as the “CEC Pilot Study”. **Table 1** summarizes the key documents in the development of the Stakeholder Work Plan and subsequent implementation by the Delta RMP. The Stakeholder Work Plan is based on the State Water Board CEC pilot study monitoring guidance that was directly informed by the result of a technical report prepared for the State Water Board by the Southern California Coastal Water Research Project (SCCWRP). The CEC TAC advises the Delta RMP Steering Committee on technical issues related to implementation of the Stakeholder Work Plan.

The Regional Water Board adopted Resolution R5-2021-0054 in October 2021 that specifies requirements for study plan development and data deliverables. This “Delta RMP Resolution” was adopted after the Delta RMP approved the three-year CEC Pilot Study. Although the Delta RMP Steering Committee had previously approved the CEC Pilot Study, the Delta RMP Resolution is addressed in this Year 3 Study Plan as shown in **Table 2**.

The Delta RMP will develop the CEC Year 3 Quality Assurance Project Plan (Year 3 QAPP) based on this Year 3 Study Plan and will implement the program once funding is approved.

Table 1: Central Valley CEC Pilot Study documents

KEY DOCUMENT	DATE	REFERENCE NAME
Monitoring Strategies for Chemicals of Emerging Concern (CECs) in California's Aquatic Ecosystems Recommendations of a Science Advisory Panel. submitted at the request of the California Water Resources Control Board by the Southern California Coastal Water Research Project. Technical Report 692	April 2012	SCCWRP Science Panel Recommendations
Monitoring of Constituents of Emerging Concern (CECs) in Aquatic Ecosystems – Pilot Study Guidance. Nathan G. Dodder, Alvine C. Mehinto, and Keith A. Maruya	March 2015	Pilot Study Design and QA/QC Guidance
Constituents of Emerging Concern (CECs) Statewide Pilot Study Monitoring Plan. State Water Board	January 2016	Statewide CEC Pilot Study Monitoring Plan
Central Valley Pilot Study for Monitoring Constituents of Emerging Concern (CECs) Work Plan. Larry Walker Associates on behalf of Stakeholder Group	July 2018	Stakeholder Work Plan
Quality Assurance Project Plan Pilot Study of Constituents of Emerging Concern in the Sacramento-San Joaquin Delta. Aquatic Science Center. Updated by MLJ Environmental	October 2021 (update)	CEC QAPP
Approval of Delta Regional Monitoring Program Governance Structure and Implementing Entity Resolution R5-2021-0054. Central Valley Regional Water Quality Control Board	October 2021	Delta RMP Resolution

Table 2: Delta RMP Resolution required study plan requirements and associated Year 3 Study Plan location.

DELTA RMP RESOLUTION REQUIREMENT	ASSOCIATED YEAR 3 STUDY PLAN SECTION
Specific hypothesis to be tested (only study questions provided for this pilot study)	**CEC Gradient Study** Questions
Sample locations	**Sample Collection Locations**
Sample collection frequency	**Sample Collection Frequency and Timing**
Sample analytes	**Sample Analytes and Methods**
Analysis methods	**Sample Analytes and Methods**
Preliminary data deliverables	**Data Deliverables and Reports**
Planned reports to summarize results	**Data Deliverables and Reports**
Timeline and schedule for all of the study design elements to be completed	**Study Timeline and Schedule**

DELTA RMP CEC MONITORING

The Stakeholder Work Plan specifies collection of targeted chemistry analyses in aqueous, sediment, and tissue matrices over a three-year period with different elements in each year. The first two years of the CEC Pilot Study were completed in 2019-20 (Year 1) and 2020-21 (Year 2) as follows:

- Year 1 – ambient monitoring. The first year of monitoring included ambient monitoring to assess the presence of the targeted CECs at specific locations in the Delta.
- Year 2 – ambient and source monitoring. The second year of monitoring continued the ambient monitoring conducted during the first year and added source characterization sites to monitor POTW effluent and MS4 urban runoff.

Due to COVID-19 health and safety limitations, three site locations (Sacramento River at Hood, Sacramento River at Freeport, and San Joaquin River at Buckley Cove) were each not sampled during one event in Year 1; this equates to one event out of the eight total Year 1 and Year 2 events. As part of the Year 3 Study Plan development the CEC TAC considered whether to collect the missed samples during Year 3. This is discussed further under Sample Locations.

The Delta RMP prepared the preliminary data summary (**Appendix B**) from the first two years of CEC monitoring to inform this Year 3 Study Plan. The preliminary data summary includes CEC detection rates, monitoring site concentration plots, and an assessment of contamination issues.

Year 3 sample collection is scheduled for 2023-24, pending Delta RMP Steering Committee recommendation, and Delta RMP Board of Directors' approval. The Year 3 Study Plan will be incorporated into the fiscal year 2023-24 (FY 23-24) Workplan that is due to the Regional Water Board on May 1, 2023, along with the CEC Year 3 QAPP. Both the FY 23-24 Workplan and the CEC Year 3 QAPP must be approved by the Regional Water Board prior to the Year 3 Study Plan implementation. Delta RMP completion of the following Stakeholder Work Plan elements will complete the CEC Pilot Study:

- Year 3– gradient study and second year of source monitoring. The third year continues only the source monitoring from Year 2 and adds gradient studies upstream and downstream of POTWs.

The Year 3 gradient study evaluates POTW discharge CEC attenuation in Dry Creek in Roseville, CA and in Old Alamo Creek near Vacaville, CA. These receiving waters are consistent with effluent dominated inland waters (Scenario 1) identified in the Statewide

CEC Pilot Study Monitoring Plan.[1] The Delta RMP CEC TAC reviewed the Year 1 and Year 2 preliminary data summaries (**Appendix B**) and recommended including all Stakeholder Work Plan constituents in the Year 3 study. All constituents were detected in POTW source waters or immediately downstream. Bisphenol A was detected in method blanks and/or field blanks in each event at concentrations similar to environmental concentrations. Therefore, bisphenol A was recommended for Year 3 sample collection and analysis methods evaluation.

DELTA RMP MANAGEMENT QUESTIONS

Table 3 summarizes the technical approaches to address the Statewide CEC Pilot Study Monitoring Plan. The CEC Pilot Study was designed based on study objectives and study questions from the Stakeholder Work Plan, which was developed outside of the Delta RMP. However, the CEC Pilot Study does begin to inform a Delta RMP management question:

Is there a problem or are there signs of a problem?

The CEC Pilot Study will provide an initial assessment of conditions through consideration of the Statewide CEC Pilot Study Monitoring Plan monitoring questions that are identified in **Table 3**. This Year 3 Study Plan addresses the bolded row in **Table 3:**

How quickly (i.e., at what distance) do the CECs attenuate once discharged?

The Delta RMP will address the other **Table 3** study questions using the collective three-year data set.

Table 3: Monitoring questions for the CEC Pilot Study.

2016 Statewide Monitoring Plan Monitoring Questions	Technical Approach to Address Monitoring Questions
POTWs	
Which CECs are detected in freshwaters and in which California watersheds are they detected?	Monitor to determine detection of CECs at boundaries of the Delta and within the legal Delta over multiple years and conditions.
Can the CECs be shown to originate from the inland WWTP, or are they present at background concentrations?	Compare observed concentrations at upstream boundaries or locations and downstream monitoring locations.

[1] "Alamo Creek downstream of the Vacaville Easterly WWTP and Pleasant Grove downstream of the City of Roseville Pleasant Grove WWTP" is specified in the Statewide CEC Pilot Study Monitoring Plan. However, Dry Creek in Roseville was recommended in the Stakeholder Work Plan as a more ideal study location with fewer outside sources.

2016 Statewide Monitoring Plan Monitoring Questions	Technical Approach to Address Monitoring Questions
How quickly (i.e., at what distance) do the CECs attenuate once discharged?	**Perform a gradient study to evaluate concentrations at multiple locations downstream from discharges to evaluate CEC attenuation over distance.**
What are the concentrations and loadings of target CECs in the dry vs. wet seasons?	Compare wet and dry season concentrations and loadings at individual source characterization and ambient sites.
Do the new occurrence data change the estimated monitoring trigger quotients (MTQs)?	Compare maximum detected ambient values to determine if site-specific MTQ is greater than or less than unity (1.0).
Which detected CECs have been found to accumulate in sediments and fish tissue?	Compare water column detected concentrations to paired sediment and tissue samples. Calculate average accumulation ratios.
MS4s	
Which CECs are detected in waterways dominated by stormwater?	Monitor to determine detection at the American River at Discovery Park monitoring location during wet weather conditions.
What are their concentrations and loadings in the dry vs. wet seasons?	Compare wet and dry season concentrations and loadings at individual source characterization sites.
What is the relative contribution of CECs in WWTP effluent vs. stormwater?	Compare wet and dry weather source characterization loading estimates for urban area runoff and POTW discharge relative to ambient flux.
What is the spatial and temporal variability in loadings and concentration (e.g., between storm variability during the wet season; in stream attenuation rate during low flow, dry season conditions)?	There is insufficient sample collection included in the Work Plan to perform a robust variability assessment; however, significant trends may be detectable when evaluated with other (external) data and work by MS4s (e.g., statistical loading models).

Note: Bolded question is addressed in this Year 3 Study Plan

CEC GRADIENT STUDY QUESTIONS

The three-year Stakeholder Work Plan design was approved by the Delta RMP prior to the Regional Water Board Resolution that now requires a study hypothesis. This Study Plan was developed based on the specified number of study areas (two POTWs and two receiving waters), sample collection locations (seven in total), and sample frequency (2 dry weather events). While study hypotheses could be developed to evaluate attenuation, the number of samples specified in the Stakeholder Work Plan would likely be insufficient to have statistical significance and the Stakeholder Work Plan study questions can be addressed without a specific hypothesis test. Moreover, the Stakeholder Work Plan is a pilot study intended to inform future monitoring design with initial data collection and evaluation.

This Year 3 Study Plan includes testable study questions that inform the next steps, including future hypotheses development in regional CEC monitoring programs. The Year 3 Study Plan study questions are as follows:

1. For each of the CEC constituents, what is the attenuation at distances downstream from the POTW discharge?
2. For each of the CEC constituents, can the relative magnitude of the type of attenuation (hydraulic or degradation/inputs) be quantified based on a simple mass balance with available flow, travel time, and concentration measurements or estimates?

The Year 3 gradient study will characterize the spatial distribution of CECs and hydraulic dilution of CECs. The study reaches are designed to be long enough to gather information about both the attenuation of CECs expected to attenuate rapidly and persistent CECs. The study will inform future studies on degradation rates and sample collection strategies and methods.

SAMPLING STRATEGY

To answer the CEC Pilot Study questions with a limited number of samples and expected lack of upstream flow at some targeted ambient monitoring sites, a site prioritization strategy is necessary. Prior to mixing with main stem[2] and tributary[3] confluences and absent new sources, changes in surface water CEC concentrations would occur due to degradation or partitioning into sediments or aquatic organisms. While each of the CECs may have different attenuation rates, these processes were assumed to follow an exponential decay [4] for this design strategy where the absolute magnitude of attenuation (decay) is higher where CECs exist at higher concentrations (i.e., near to the source signal). The downstream sites were chosen at increasing distances downstream from the POTW source to follow the expected exponential decay curve model for attenuation of CECs along the study reaches. If sites were located equidistant from each other, the absolute concentration difference between sites would get increasingly smaller. The smaller differences may be more difficult to measure at the expected low concentrations. First order decay is just one consideration in site selection in addition to access (logistical and safety) considerations that are discussed later.

The gradient study mass balance and point of attenuation schematics in **Figure 1** identify the variables within the study system. **Figure 1** identifies the study "flow path" which is the downstream path of POTW effluent where attenuation distance is measured. The Statewide CEC Pilot Study Monitoring Plan does not specify the definition of "point of attenuation" and whether it is 1) any decrease in concentration or 2) decrease to background concentration. For CEC Pilot Study question testing, this point is assumed to be the first downstream point after the source at which the concentration decreases and does not increase at the next downstream point on average for the two study events.

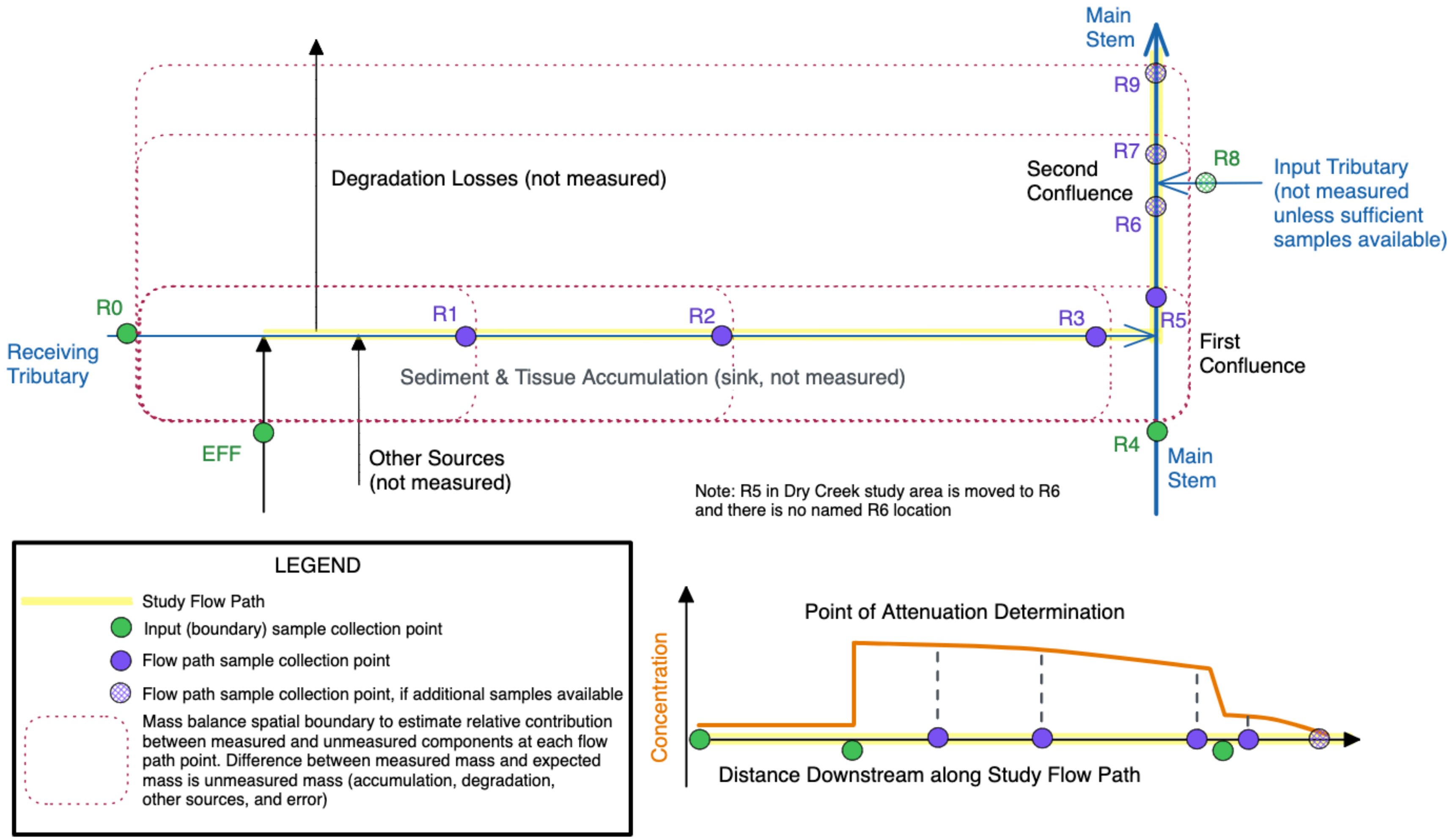
At each of the flow path sample locations a mass balance spatial boundary can be defined as shown in **Figure 1**. For each of these spatial boundaries (i.e., each flow path sample location) a mass flux balance can be performed where mass flux (mass per time) is the product of flow and concentration. A generalized mass balance equation would be:

$$mass\ flux_{in} = mass\ flux_{out} + unmeasured\ massflux + mass\ acumulation\ rate - mass\ decay\ rate + error$$

[2] "Main stem" is the named waterbody that continues downstream of the confluence (e.g., the tributary Dry Creek merges with the main stem Steelhead Creek).
[3] "Tributaries" are any waterbodies that flow to the main stem.
[4] dC/dt = -kC for a first order decay reaction. Where k is the decay rate and C is the concentration of the contaminant.

In the case of this study design, the mass flux in and the mass flux out (blue terms in the above equation) are the only factors measured; the remaining factors are considered potential factors that would result in the mass flux in and the mass flux out being unequal. Unmeasured mass flux are external inputs or outputs (e.g., storm drain) that are not measured in this Study Plan but may be visually observed. Mass can accumulate within the spatial boundary in the sediments, uptake to plants, or uptake to aquatic life. Error may also be introduced through any of the flow or concentration measurements and collection timing. The Study Plan specifies collection of mass flux in and out of the spatial boundary. When these values are not equal, the difference can be attributed to the other equation terms.

Figure 1: Gradient study mass balance schematic and flow path point of attenuation diagram.



Wherever possible, inputs to the study flow path will be measured upstream of the study flow path and immediately downstream to evaluate the effects of additional inputs on any observed attenuation. For each study area (i.e., "POTW 1" for Dry Creek and "POTW 2" for Old Alamo Creek), the three waterbodies evaluated are:

- **Receiving tributary** – the immediate receiving water for the effluent. The effluent input and, if applicable, any upstream inputs will be monitored as the input samples for this waterbody. Three study flow path samples will be collected from to the first confluence with the main stem as shown in **Table 4**.
- **Main stem** – the larger waterbody into which the receiving tributary flows at the first confluence. If there is water upstream of the receiving tributary, the upstream input and immediately downstream of the confluence will be monitored. Includes the additional sites along the main stem leading up to the second confluence.
- **Input tributary** – an additional tributary which meets the main stem at the second confluence. The input tributary upstream and downstream of the main stem confluence will only be monitored when there are insufficient input sites on the receiving tributary and main stem to reach seven sample locations.

Table 4. Waterbodies assessed for each gradient study area.

WATERBODY TYPE	SITES	STUDY AREA POTW 1	STUDY AREA POTW 2
Effluent	EFF	POTW1	POTW2
Receiving Tributary	R0, R1, R2, R3	Dry Creek	Old Alamo Creek
Main Stem	R4, R5, R6, R7, R9	Steelhead Creek	New Alamo Creek
Input Tributary	R8	Robla Creek	Ulatis Creek

Each study area will be sampled at seven sites according to the decision trees provided in **Figure 2** and **Figure 3**. The preferred sample locations would assess the effluent, an upstream input, and five downstream locations (R1-R5). Given the dry season conditions in which sampling will occur, up to four alternate sites (R6-R9) further downstream on the main stem and input tributaries have also been identified such that a total of seven samples can still be collected if the upstream input site (R0) and/or the main stem input site (R4) do not have flowing water to be sampled.

Any samples collected immediately downstream of a confluence with both waterbodies flowing should be collected as spatial (transect) composite samples (if safe to do so). All other samples will be collected as single grab samples as outlined below.

The **Figure 2** sample collection strategy maximizes the limited number of Stakeholder Work Plan specified samples per study area ("1 effluent, 1 upstream receiving water, and 5 downstream receiving water") to answer the study questions. The **Figure 2** strategy will result in one of four possible scenarios for the seven available samples per event per study area per event.

- The first scenario is if the upstream site is not dry and the first confluence is not dry. In scenario one, the design includes all preferred sites including the upstream (1), effluent (2), R1 (3), R2 (4), R3 (5), R4 (6), and R5 (7) sites.
- The second scenario is if the upstream site is not dry but the first confluence it. In scenario two, the design includes 6 preferred locations and one alternate site, including the upstream (1), effluent (2), R1 (3), R2 (4), R3 (5), R5 (6), and R6 (7) sites.
- The third scenario is if the upstream site is dry, and the first confluence is not. In scenario three, the design also includes six preferred sites and one alternate site (similar to scenario two) including the effluent (1), R1 (2), R2 (3), R3 (4), R4 (5), R5 (6), and R6 (7) sites.
- The fourth scenario is if the upstream site is dry, and the first confluence is dry. In scenario four, the design includes five preferred sites and two alternate sites including the effluent (1), R1 (2), R2 (3), R3 (4), R5 (5), R6 (6) and R7 (7) sites.

In addition to these four scenarios, if any of the sites cannot be sampled alternate sites R8 and R9 would be sampled to ensure that seven samples are collected. In the case of the POTW 1 study area, R6 does not have a sample location since R5 and R7 are so close together. In this case, the sequence in **Figure 3** skips R6 and goes directly to R7 depending on the scenario.

“Preferred sites” are those that would be sampled if flow is measured at R0 and R4 and “alternate sites” are pre-designated sites that would be sampled based on the observed conditions as follows (site types are listed in **Table 5** and specified in the **Sample Collection Locations** section).

Preferred Sites:

- Collect the upstream of POTW discharge (Upstream) ambient sample at mid-stream and mid-depth in the morning (before 9AM) and measure upstream flow. If upstream flow is zero, no sample will be collected. If no upstream sample is collected, an additional downstream sample will be collected (for a total of six downstream samples).
- Collect grab effluent sample (Effluent) in the morning just after the upstream sample collection (9AM).

- Collect the three (R-1, R-2, and R-3) mid-stream and mid-depth[5] downstream samples to the first confluence. Begin downstream sample collection closest to the discharge point, and end sample collection at the site furthest from the discharge point. Samplers will be instructed to minimize sediment disturbance as much as possible.
- If there is main stem upstream flow at the first confluence with Steelhead Creek or Old Alamo Creek main stems, collect samples in the main stem upstream and downstream of the tributary confluence. If wadable, the upstream sample should be taken as a grab sample at mid-stream, mid-depth. If wadable, the site immediately downstream of the first confluence should be collected as an approximate transect composite sample to account for incomplete mixing of the two waterbodies. For locations immediately downstream from a confluence a transect composites are collected by filling the sample bottle one-third for each of three mid-third, mid-depth locations in a transect across the main stem (i.e., near third, middle third, and far third). If not wadable, a shore grab as far into the stream as possible is acceptable.

Alternate Sites:

- If there is no main stem upstream flow at the Steelhead Creek or Old Alamo Creek confluence with the receiving water tributary, collect a mid-stream, mid-depth grab sample on the main stem downstream of the confluence (R5) and on the main stem at the next downstream location above the next flowing tributary confluence R6 (if applicable). Shore samples can be taken if the main stem is not wadable. Continue this approach at each confluence between the main stem and a tributary input until the total sample collection points reaches seven. If it is not possible to sample at a location as described in **Figure 2** and the **Sample Collection Methods** section of this document, continue to the next downstream main stem location (upstream of the next input tributary confluence).
- If there is no flow at either the upstream Dry Creek site (R0) or the upstream Steelhead Creek site (R4), samplers will proceed directly from the flow path main stem site (R5) to the Steelhead Creek site downstream of the second confluence with Robla Creek (R7). There is no R6 site identified for Steelhead Creek because the distance along the main stem between the first confluence (terminus of Dry Creek) and the second confluence (terminus of Robla Creek) is relatively short compared to the scale of the overall study area (500 meters compared to > 20 kilometer study area) with no known inputs between those two confluences.

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[5] In low flow conditions, mid-stream, mid-depth samples should be collected from the portion of the waterbody with the swiftest current.

Therefore, there is not likely an appreciable difference in attenuation between a sample collected immediately downstream of Dry Creek and a sample collected immediately upstream of Robla Creek and an additional sample (R6) along this section of the main stem would be redundant. The R5 site on Steelhead Creek will serve the purpose of evaluating the sample flow path as influenced by any upstream inputs from Steelhead Creek, as well as establishing the main stem conditions prior to the input tributary of Robla Creek. If there is flow at the upstream main stem site (R4), then a transect composite will be collected at R5 to account for potential mixing occurring at that confluence. If an additional sample is required after the main stem (R5) site, sampling crews will proceed to the site downstream of the second confluence (R7), followed by R8 and R9, if needed.

- Though considered a "main stem" waterbody for the purposes of this study, New Alamo Creek is a tributary to Ulatis Creek. If this confluence is reached (i.e., samples are added beyond the five to six downstream receiving water samples), the New Alamo Creek terminus (R6) sample and downstream (composite) confluence (R7) samples should be collected. If needed to reach a total of seven samples, field crews will collect an additional grab sample from Ulatis Creek, upstream of the New Alamo Creek confluence (R8). If the five (or six) receiving water samples have already been collected the sample collection priority order is: New Alamo Creek terminus, main stem downstream of the confluence, and main stem upstream of the confluence.
- If for any reason seven total samples have not been reached, then a sample should be collected from the final alternate site (R9).

At all ambient (non-effluent) locations the following data should be collected:

- Water depth at mid-stream
- Mid-stream flow measurement parameters (see section **Flow Measurement Methodologies** for details).
- Photographs of site location and surrounding conditions
- Field measurements for specific conductance, pH, and temperature
- Atmospheric temperature and weather conditions
- Latitude and longitude coordinates

Table 5 is a summary of the expected gradient sample locations including priority numbering based on the monitoring strategy. The **Sample Collection Locations** section below contains specific details about the locations.

Figure 2: Gradient study sample collection strategy.

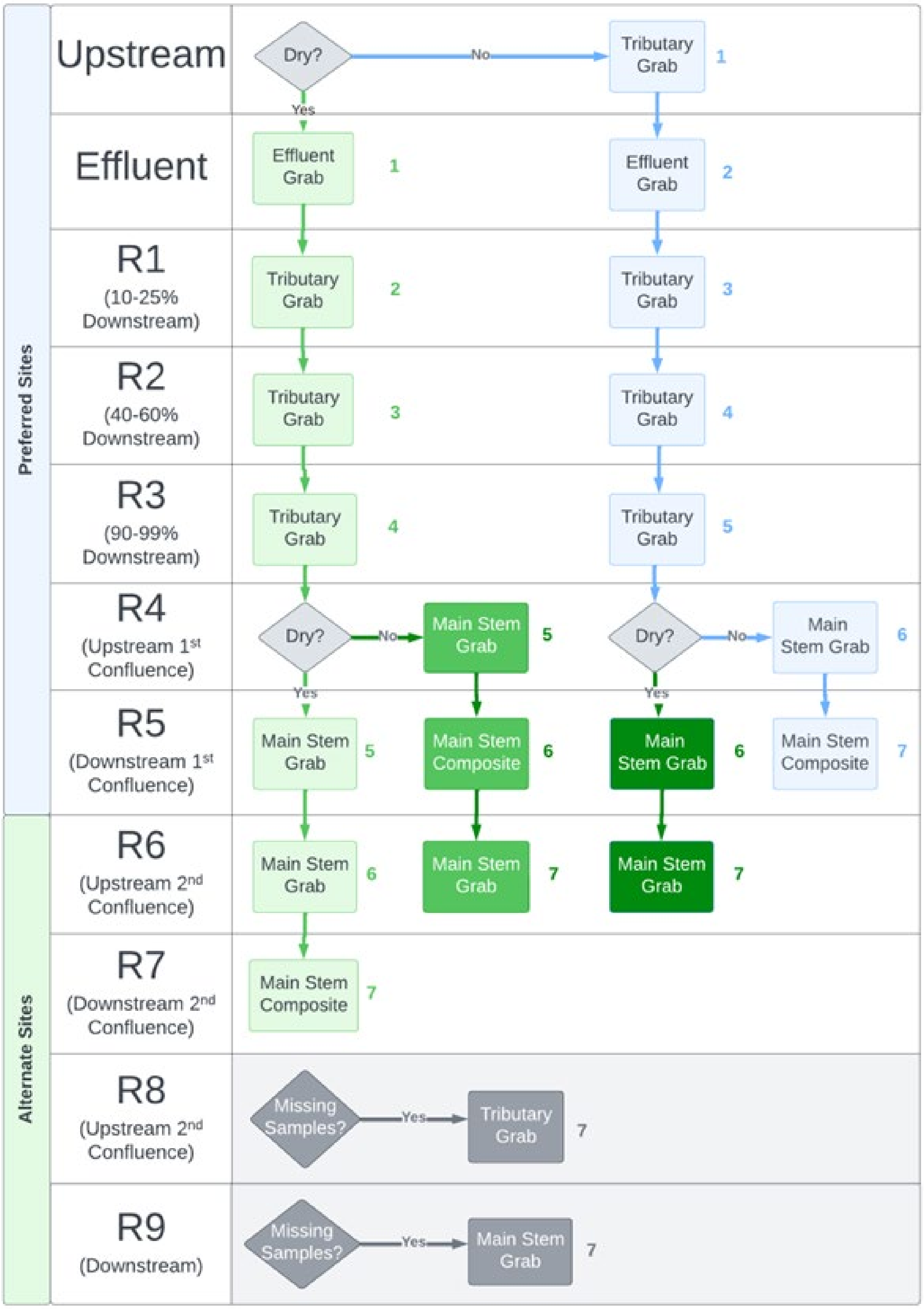

Figure 3. Adjusted gradient sample collection strategy for the POTW 1 study area.
An R6 monitoring site is not identified for the POTW 1 study area because the relatively short distance (500 meters) between the first and second confluence would result in redundant data collection. If necessary, samplers will proceed from R5 (downstream of the first confluence) to R7 (downstream of the second confluence) for the POTW 1 study area.

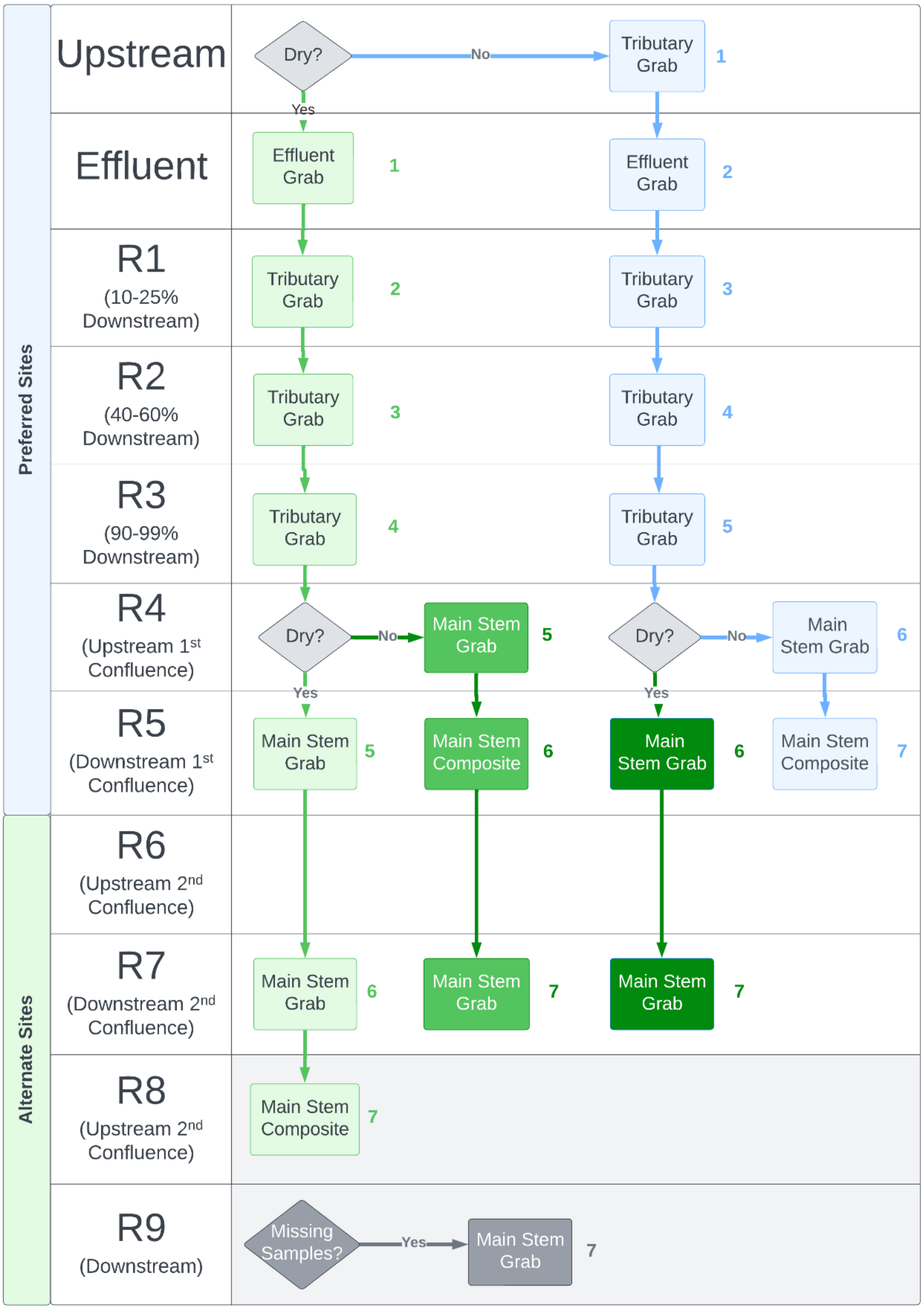

Table 5: Gradient sample types, descriptions, and sampling priority for additional sites.

Gradient Sample Type	Waterbody	Sample Type	Site Location Description
Preferred Sites			
R0	Receiving Tributary	Input	Upstream location in NPDES permit. If site has no upstream flow, do not collect sample and add a downstream location.
EFF	NA	Input	Effluent sample at NPDES permit location or equivalent as a grab sample.
R1	Receiving Tributary	Flow Path	First receiving water (tributary) downstream location.
R2	Receiving Tributary	Flow Path	Second receiving water (tributary) downstream location.
R3	Receiving Tributary	Flow Path	Third receiving water (tributary) downstream location.
R4	Main Stem	Input	Upstream of confluence on main stem, if flow is not measurable, move to R6.
R5	Main Stem	Flow Path	Downstream of confluence on main stem if flow is measurable at R4.
Alternate Sites			
R6	Main Stem	Flow Path	Main stem upstream of next flowing tributary confluence.
R7	Main Stem	Flow Path	Main stem downstream of next flowing tributary confluence.
R8	Input Tributary	Input	Tributary upstream of confluence with main stem.
R9	Main Stem	Flow Path	Main stem gradient site not associated with a confluence

SAMPLE COLLECTION LOCATIONS

This Year 3 gradient study will evaluate two POTW effluent gradients, each consisting of one upstream site, one POTW effluent site, and up to five downstream sites in Old Alamo Creek and Dry Creek. Municipal separate storm sewer systems (MS4) urban runoff monitoring sites will be sampled in Roseville and Sacramento that do not directly inform the gradient study but are part of the full three-year CEC study. For each of the two events, the Delta RMP will collect water or effluent samples at a total of sixteen site locations. Other ambient locations sampled in Year 1 and Year 2 will not be sampled in Year 3.

In December 2021, the Steering Committee discussed whether additional sampling should occur during FY 22-23 to capture the missed samples from Year 1. In the Delta RMP FY 22-23 Workplan the Steering Committee referred the issue to the CEC TAC to evaluate the merit of collecting the missed samples during FY 23-24 as part of the Year 3 Study Plan.

As discussed in the Year 2 Data Report, the CEC TAC did not recommend collecting additional samples from the three sites where one sample was missed during Year 1 of the CEC Pilot Study. The Year 2 Data Report also did not recommend re-sampling sites where samples did not meet measurement quality objectives, but did recommend the addition of laboratory split and travel blanks for bisphenol A.

URBAN RUNOFF SOURCE CHARACTERIZATION MONITORING SITES

The Year 3 MS4 stormwater monitoring sites are existing MS4 sites located in Roseville and Sacramento (**Table 6**).

Table 6: MS4 stormwater monitoring sites, CEDEN station code, latitude, and longitude.

STATION DESCRIPTION	CEDEN STATION CODE	LATITUDE	LONGITUDE
Sacramento Urban Runoff 3; Sump 111	519SACUR3	38.60127	-121.49296
Roseville Urban Runoff	519PGC010	38.80477	-121.32733

GRADIENT MONITORING LOCATIONS

The gradient monitoring locations described in the **Sampling Strategy** section include POTW effluent, upstream receiving water, and downstream receiving water locations. In cases where an upstream main stem or tributary does not have flow (and a sample cannot be taken) the sample is shifted downstream as described in the **Sampling Strategy** section. Gradient study areas are shown in the **Figure 4** and **Figure 5.** maps for Dry Creek and Old Alamo Creek, respectively. The maps show the additional potential locations if flow is not present upstream of POTW discharge or upstream at the first main stem (Steelhead Creek and New Alamo Creek) or if sampling cannot be conducted at any other preferred locations.

The gradient study receiving water sites were selected to determine the distance at which CECs attenuate downstream of the POTW effluent discharges.[6] Based on the monitoring strategy, field crews verified likely sites' accessibility, safety concerns and dry weather conditions using aerial imagery and follow-up site visits.

POTW Effluent

The effluent monitoring sites for POTW discharges to Dry Creek and Old Alamo Creek effluent are existing monitoring sites from Years 1 & 2, shown in **Table 7** and in **Figure 4** and **Figure 5**.

Table 7: POTW effluent monitoring locations, CEDEN station codes, latitude, and longitude

Station Description	Gradient Sample Type	CEDEN Station Code	Latitude	Longitude
POTW Source 1 effluent discharge to Dry Creek	EFF	519POTW01	38.7339	-121.31505
POTW Source 2 effluent discharge to Old Alamo Creek	EFF	511POTW02	38.34664	-121.90156

Upstream Locations

The upstream receiving water monitoring locations for Old Alamo Creek and Dry Creek gradients are shown in **Figure 4** and **Figure 5** and listed in **Table 8**. The upstream receiving water site in Dry Creek is an established monitoring site from Years 1 & 2.

[6] LWA, et al. July 2018. *Central Valley Pilot Study for Monitoring Constituents of Emerging Concern (CECs) Work Plan.*

Table 8: Upstream receiving tributary monitoring locations, CEDEN station codes, latitude, and longitude.

Station Description	Gradient Sample Type	CEDEN Station Code	Latitude	Longitude	Distance Upstream From Discharge (meters)
Dry Creek before POTW Source 1	R0	519DRYCRK	38.7341	-121.31444	60
Old Alamo Creek Before POTW Source 2	R0	TBD	38.34741	-121.90507	320

Downstream Receiving Water Locations

The Delta RMP will collect samples at five POTW receiving water and downstream sites, and up to six locations if the upstream receiving water location is dry.

POTW1 Downstream Receiving Water Locations

Downstream receiving water monitoring sites through the first confluence (R1-R5) and additional receiving water monitoring sites (R7-R9) for the POTW1 gradient are shown in **Figure** 4 and listed in **Table 9**, **Table 10**, and **Table 11**. An R6 monitoring site is not identified for the POTW 1 study area because the relatively short distance (500 meters) between the first and second confluence would result in redundant data collection. For the POTW 1 study area, the R5 sample serves as the sample that will be representative of water downstream of the first confluence and upstream of the input from the second confluence.

Additional sampling sites were pre-determined from the confluence between Magpie Creek and Steelhead Creek until the confluence between Steelhead Creek and the Sacramento River at Discovery Park.

During Year 3 Study Plan development, Delta RMP field crews could not access the main stem Steelhead and Magpie Creek terminus confluence, or the main stem Steelhead Creek and Arcade Creek terminus confluence. Field crews will scout the area again to determine if there is a feasible access point for the farthest downstream alternate site (R9) that is closer to the other gradient study sites. Any changes to monitoring locations will require CVRWQCB and State Board QA Officer approval prior to implementation.

Figure 4: Dry Creek and downstream gradient monitoring locations.

An R6 monitoring site is not identified for the POTW 1 study area because the relatively short distance (500 meters) between the first and second confluence would result in redundant data collection. For this study area, the R5 sample will represent water downstream of the first confluence and upstream of the input from the second confluence.

Figure 4Table 9Table 10Table 11Table 9: POTW 1 study area receiving tributary flow path monitoring locations.

Station Description	Gradient Sample Type	CEDEN Station Code	Latitude	Longitude	Distance From Discharge (meters)	Site Location Basis
Dry Creek at Cook Riolo Rd bridge	R1	TBD	38.736961	-121.337125	2,200	Accessible from roadway
Dry Creek at Watt Ave bridge	R2	TBD	38.734564	-121.392525	7,300	Accessible from roadway; increasing distance from previous location
Terminus of Dry Creek at Rio Linda Blvd	R3	TBD	38.671019	-121.454769	17,000	Accessible from roadway; increasing distance from previous location

Table 10: POTW 1 study area preferred main stem monitoring locations.

Station Description	Gradient Sample Type	CEDEN Station Code	Latitude	Longitude	Distance From Discharge (meters)	Site Location Basis
Steelhead Creek main stem Upstream of confluence with Dry Creek	R4	TBD	38.665806	-121.477325	NA	Accessible upstream on main stem

Station Description	Gradient Sample Type	CEDEN Station Code	Latitude	Longitude	Distance From Discharge (meters)	Site Location Basis
Steelhead Creek main stem Downstream of confluence with Dry Creek and upstream of the confluence with Robla Creek	R5	TBD	38.6596	-121.47605	20,200	Accessible downstream on main stem. Closest accessible location upstream of Robla Creek to allow for maximum mixing after the confluence with Dry Creek.

Table 11: POTW 1 study area alternate monitoring locations.

Station Description	Gradient Sample Type	CEDEN Station Code	Latitude	Longitude	Distance From Discharge (meters)	Site Location Basis
NA	R6 [1]	NA	NA	NA	NA	NA
Steelhead Creek main stem downstream of Robla and Steelhead Creek confluence	R7	TBD	38.6565	-121.475453	20,600	Closest accessible downstream of Robla Creek
Terminus of Robla Creek at Rio Linda Blvd	R8	TBD	38.667169	-121.451289	NA	Closest accessible location to terminus of Robla Creek
NA	R9 [2]	NA	NA	NA	NA	NA

[1] An R6 monitoring site is not identified for the POTW 1 study area because the relatively short distance (500 meters) between the first and second confluence would result in redundant data collection.

[2] Per recommendation from the Regional Water Board, additional scouting for a location that is on the main stem gradient and not associated with a confluence will occur prior to implementation of Year 3 monitoring. Original scouting led to the selection of a site that was determined to be too close to the Sacramento River confluence and too far from the other gradient study sites. Any changes to monitoring locations in this table must be approved by the CVRWQCB and State Board QA Officer prior to implementation.

POTW2 Downstream Receiving Water Locations

Downstream receiving water monitoring (R1-R5) and additional receiving water monitoring (R6-R8) sites for the POTW2 gradient are shown in **Figure 5** and listed in **Table 12**, **Table 13**, and **Table 14**. Access to locations is limited based on unpaved road conditions, private land ownership, and fencing. Locations were then selected primarily based on roadway accessibility. Some locations are known to have hydraulic structures (e.g., weirs, check dams, etc.) where flow can be measured accurately.

An additional site not associated with a confluence (R9) was identified for the POTW2 gradient before the gradient stream system enters a tidal slough (**Table 14**). This additional site (R9) is the furthest downstream site that should be sampled if there are dry conditions along the POTW2 gradient during sample collection.

Figure 5: Old Alamo Creek and downstream gradient monitoring locations.

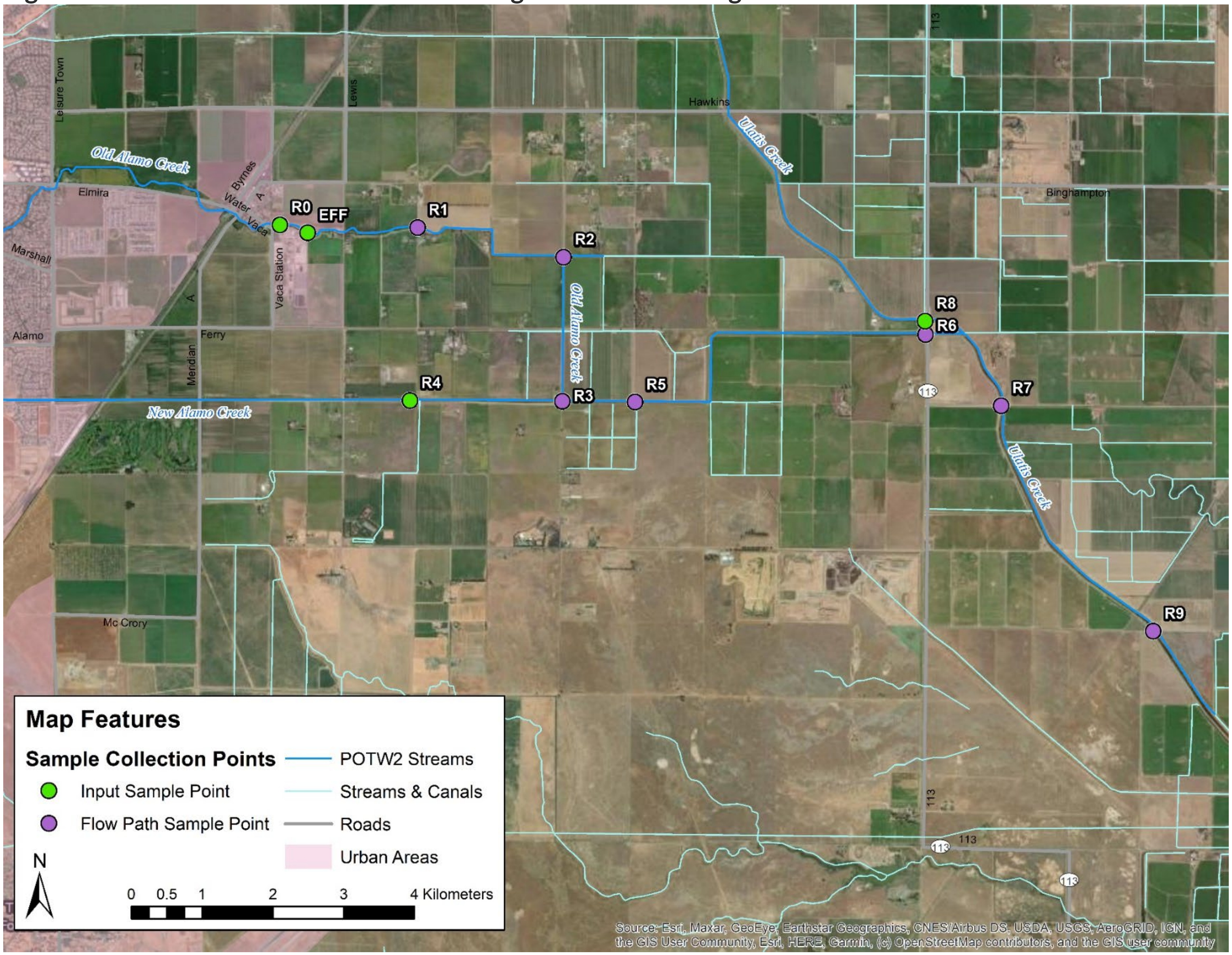

Table 12: POTW 2 study area receiving tributary flow path monitoring locations.

Station Description	Gradient Sample Type	CEDEN Station Code	Latitude	Longitude	Distance From Discharge (meters)	Site Location Basis
Old Alamo Creek at Chicorp Ln.	R1	TBD	38.347147	-121.887617	1,300	Accessible location used as part of other study
Old Alamo Creek at Sunnybrook Ln.	R2	TBD	38.344197	-121.869089	3,200	Accessible location used as part of other study. Samples to be collected upstream of ag drains
Terminus of Old Alamo Creek before confluence with New Alamo Creek	R3	TBD	38.329869	-121.869231	4,800	Furthest downstream accessible location prior to confluence. Available flow measurement structure

Table 13: POTW 2 study area preferred main stem monitoring locations.

Station Description	Gradient Sample Type	CEDEN Station Code	Latitude	Longitude	Distance From Discharge (meters)	Site Location Basis
New Alamo Creek upstream of confluence with Old Alamo Creek	R4	TBD	38.329939	-121.888569	NA	Available flow measurement structure
Alamo Creek downstream of confluence between New and Old Alamo Creeks	R5	TBD	38.329789	-121.860019	5,500	Available flow measurement structure

Table 14: POTW 2 study area alternate monitoring locations.

Station Description	Gradient Sample Type	CEDEN Station Code	Latitude	Longitude	Distance From Discharge (meters)	Site Location Basis
Terminus of Alamo Creek before confluence with Ulatis Creek	R6	TBD	38.336511	-121.823136	9,500	Available flow measurement structure
Ulatis Creek downstream of confluence with Alamo Creek from Maine Prairie Rd.	R7	TBD	38.329431	-121.813564	10,800	Nearest accessible downstream location
Ulatis Creek main stem upstream of confluence with Alamo Creek	R8	TBD	38.337831	-121.823219	NA	Nearest accessible upstream (Ulatis) location
Ulatis Creek additional downstream site not associated with a confluence	R9	TBD	38.307011	-121.79425	13,900	Furthest downstream additional location

SAMPLE COLLECTION FREQUENCY AND TIMING

The Delta RMP will collect gradient and MS4 urban runoff samples during two dry weather events as part of the Year 3 study. It is recommended that the two events be separated by at least two weeks. The Delta RMP Resolution specifies annual deadlines for planning and reporting. It is expected that the Delta RMP will complete Year 3 CEC gradient monitoring by October 2023. However, field conditions may require event rescheduling to avoid wet weather as the gradient study is intended to assess effluent-dominated receiving waters. As prescribed in the Delta RMP Resolution, sampling and monitoring results will be submitted within six months from the date of sample analysis. Details regarding the timing of data verification, loading in the Central Valley Regional Data Center (CV RDC) database, and migration to an approved publicly available database (e.g., CEDEN) will be documented in the Year 3 QAPP.

During dry weather, the most significant hydrologic difference at the gradient monitoring locations will be the presence of irrigation water, which will be evident based on the upstream main stem flows in Steelhead Creek, Old Alamo Creek, New Alamo Creek, and Ulatis Creek. Upstream irrigation return flows may provide hydraulic attenuation or additional CEC mass inputs. Upstream flows will not be considered in event targeting (i.e., events will not be rescheduled based on upstream flow conditions). The Delta RMP will collect flow measurements at all monitoring locations wherever flow is present and flow measurements are feasible during both events. See the Flow Measurements section for further information.

The Stakeholder Work Plan does not specify whether wet weather samples are required for the Year 3 MS4 urban runoff samples. To simplify sample collection logistics, the Delta RMP will collect MS4 urban runoff samples concurrently within three days of gradient sample collection. Dry weather urban runoff occurs in much smaller volumes than wet weather. MS4 agencies implement dry weather control and diversion programs, but there are sources of permitted non-stormwater flows in MS4 discharges.

SAMPLE ANALYTES AND METHODS

The CEC Pilot Study Work Plan recommends that the CEC analytes monitored in Year 3 of the CEC Pilot Study depend on those CECs detected in Year 2 source monitoring. The Delta RMP monitored aqueous samples for CECs listed in **Table** 15. The **Appendix B** Year 1 and Year 2 data show that each of the analytes was detected at one of the source monitoring locations or immediately downstream at receiving water locations. At multiple CEC TAC meetings (August 29, 2022, October 18, 2022, and November 17, 2022) there were no CEC TAC member objections to include the complete list of **Table** 15 CECs in Year 3 monitoring events.

Table 15: Analytes and methods for Year 3 of CEC water column monitoring.

Analyte Category	Analyte	Analyte Type	Year 1 and Year 2 Lab	Method	Units
PFAS	Perfluorooctanesulfonic acid (PFOS)	Required	Vista	EPA 537M	ng/L
PFAS	Perfluorooctanoic acid (PFOA)	Required	Vista	EPA 537M	ng/L
Physical and Conventional Parameters	Suspended Sediment Concentration (SSC)	Ancillary	Weck	ASTM D3977M	mg/L
Physical and Conventional Parameters	Total organic carbon	Ancillary	Weck	EPA 9060M	mg/L
Physical and Conventional Parameters	Turbidity	Ancillary	NA [a]	SM 2130 B	NTU
PPCPs	Bisphenol A	Required	Weck	EPA 1694M	ng/L
PPCPs	Diclofenac	Required	Weck	EPA 1694M	ng/L
PPCPs	Estradiol, 17beta-	Required	Weck	EPA 1694M	ng/L
PPCPs	Estrone	Required	Weck	EPA 1694M	ng/L
PPCPs	Galaxolide	Required	Physis	EPA 625.1M	ng/L
PPCPs	Ibuprofen	Required	Weck	EPA 1694M	ng/L
PPCPs	Triclocarban	Required	Physis	EPA 625.1M	ng/L
PPCPs	Triclosan	Required	Weck	EPA 1694M	ng/L
PPCPs	Ethynylestradiol, 17alpha-	Additional	Weck	EPA 1694M	ng/L
PPCPs	Gemfibrozil	Additional	Weck	EPA 1694M	ng/L

Analyte Category	Analyte	Analyte Type	Year 1 and Year 2 Lab	Method	Units
PPCPs	Iopromide	Additional	Weck	EPA 1694M	ng/L
PPCPs	Naproxen	Additional	Weck	EPA 1694M	ng/L
PPCPs	Progesterone	Additional	Weck	EPA 1694M	ng/L
PPCPs	Salicylic Acid	Additional	Weck	EPA 1694M	ng/L
PPCPs	Testosterone	Additional	Weck	EPA 1694M	ng/L
Physical and Conventional Parameters	Flowrate	Required	NA [b]	USGS methods	m^3/s
Physical and Conventional Parameters	Midstream Depth	Required	NA [b]	NA	m
Physical and Conventional Parameters	Specific Conductance	Required	NA [b]	EPA 120.1	µS/cm
Physical and Conventional Parameters	pH	Required	NA [b]	EPA 150.1	PH units
Physical and Conventional Parameters	Temperature	Required	NA [b]	NA	°C

Note: Based on the findings of the State Water Board *Monitoring Strategies for Constituents of Emerging Concern (CECs) in California's Aquatic Ecosystems Recommendations of a Science Advisory Panel* report that is expected to be finalized in early 2023, the Steering Committee may direct the TAC to discuss modifications to analytical methods or the analytical list. Any changes to the QAPP must be approved prior to implementation.

[a] Turbidity was collected as a field measure during years 1 and 2.

[b] Parameter will be measured in the field and recorded by field crews during year 3.

SAMPLE COLLECTION METHODS

During both dry weather monitoring events, the Delta RMP will collect sufficient sample volume for analysis of the CEC constituents in **Table** 15 according to the strategy specified in **Table** 5 and **Figure 2** and as specified in the **Gradient Monitoring Locations** section. Urban runoff source monitoring protocols will follow the Year 2 sample collection and methods, in addition to any recommended modifications identified in the Year 2 Data Report.

PRE-MONITORING EVENT SITE VISITS

Before each monitoring event, Delta RMP field crews should visit all gradient study downstream receiving water monitoring sites no less than two days and no more than three days before samples are collected. There will be at least one full day between the pre-monitoring visit and the day of sample collection to allow sufficient time to communicate the list of anticipated sample locations and for field crews to prepare sampling materials. Pre-event site visits will allow field staff to determine if any of the sites do not have measurable flow (are dry) or have safety concerns that make sampling infeasible at that location. The Delta RMP field crews will then generate a list of monitoring sites to collect samples from during the upcoming monitoring event based on the field conditions they observed during the pre-monitoring event site visits and the collection strategy outlined in **Figure 2**. The Project Manager and CVRWQCB QA Representative will review and approve the list of sites prior to monitoring. Actual sampling locations may deviate +/- 50-m from the Study Plan latitude and longitude coordinates if required by site conditions.

COLLECTION METHODS

The Year 3 sample collection methods will be the same as those specified in the CEC QAPP v2 and approved deviations. The Delta RMP will collect mid-stream, mid-depth ambient grab samples, unless otherwise specified (i.e., cross sectional composites). The samples will be collected as close to mid-stream as possible considering conditions and safety concerns. Delta RMP field crews will collect one effluent grab sample following collection of the upstream sample and before the first downstream sample. Delta RMP crews then collect ambient samples moving down the **Figure 1** flow path. If receiving water flows are estimated at one foot per second, the total travel distance in 18 hours is just over 12 miles. It is expected that the downstream locations can be sampled in a 6–8-hour period by one Delta RMP field crew. If measured velocities are slower than one foot per second, Delta RMP field crews may want to decrease the pace of downstream sample collection. While the goal is to best capture the attenuation of the measured discharge concentration and mass, this Year 3 Study Plan is not designed or expected to track a single parcel of sampled effluent as it moves downstream.

QUALITY CONTROL SAMPLES

The Delta RMP will collect quality control samples as described in the forthcoming Year 3 CEC QAPP based on this Year 3 Study Plan, the CEC QAPP v2, and any approved deviations and amendments. It is recommended that the Year 3 CEC QAPP specify collection of a field blank and field duplicate for each event. Laboratories should be required to perform laboratory blanks and laboratory control samples consistent with the CEC QAPP v2 specifications. Based on the CEC Year 2 Data Report and the **Appendix B** data from Years 1 and 2, it is recommended that the Delta RMP collect and analyze a field duplicate at a secondary lab and collect travel blanks for at least bisphenol A for each event.

FLOW MEASUREMENTS

Flow measurements are necessary to estimate mass flux of constituents and to answer study Question 2: “For each of the CEC constituents, can the relative magnitude of the type of attenuation (hydraulic or degradation/inputs) be quantified based on a simple mass balance with available flow, travel time, and concentration measurements or estimates?”

At monitoring sites without in-stream gauges or other existing methods for measuring flow, Delta RMP field crews will measure flow using one of the methods described in the **Flow Measurement Methodologies** section. A determination or measurement of “dry” means that there was no water present at the site, water was only present in isolated pools, or that a positive water velocity was not present (i.e., measured as zero flow). A determination of “unmeasurable flow” means that site conditions did not allow flow measurement and the flow was estimated based on wetted perimeter measurement and an average velocity estimate.

Flow Measurement Methodologies

Delta RMP field crews will make all in-stream flow measurements to calculate discharge (volumetric flow in cfs) according to USGS methodologies[7] wherever possible. The preferred methods for field flow measurements are methods 1 and 2 listed below. In-

[7] USGS (2010). Discharge Measurements at Gauging Stations. Chapter 8 of Book 3, Section A. Techniques and Methods 3-8A

stream velocity measurements will be collected using rotating-element mechanical, electromagnetic, acoustic doppler, or acoustic digital current point velocity current meters.

1. At any monitoring location where there is measurable stream flow velocity and a wadable channel deep enough to measure velocity using a current meter, field crews will estimate volumetric flow using the current-meter midsection method. Data will be collected using the USGS current meter measurements by wading protocol. The USGS current-meter midsection method is an accurate method of measuring volumetric flow in the field and is the preferred field flow measurement method for the CEC gradient study. Field staff will select a cross section for current meter midsection flow measurements according to the USGS site selection methodology.[7]
2. At monitoring locations with culverts or weirs, field staff will collect the necessary data about culvert or weir geometry, flow depth, and in-stream velocity to calculate volumetric flow rates in cfs.
3. Field staff will decide if there are “unmeasurable flow” conditions at monitoring locations where in-stream velocities and stream depths are below the specified limits of current meters in all accessible cross sections at the monitoring site. When a site has unmeasurable flow, field staff will use a surface float method to estimate volumetric flow rates if possible. The cross-sectional area of the stream will be measured in the field and a surface float will be used with a stopwatch to estimate velocity.
4. If any monitoring location lacks a wadable cross section (i.e., stream is too deep and current is too strong to safely wade across the channel), field staff will follow the USGS discharge measurement of deep, swift streams with a mechanical current meter. If there is a bridge located near the monitoring site, depth and velocity measurements should be taken from the bridge if safe to do so.

DATA DELIVERABLES AND REPORTS

The Delta RMP Resolution requires that the study plan specify the "Planned reports to summarize results". Data collected through Delta RMP implementation of this Year 3 Study Plan will be evaluated according to the Year 3 QAPP and applicable Delta RMP data management practices and schedules. The Year 3 Data Report will be the primary data deliverable for the Year 3 Study Plan and will present the CEC gradient study analytical results. There will only be two data points for each monitoring site; therefore, statistical conclusions will not be drawn from the data. The data will still provide useful information to answer the general question posed by the CEC Pilot Study: "Is there a problem or signs of a problem?" and provide information to answer the Year 3 CEC gradient study questions.

The primary data deliverables and data products associated with Year 3 Data Report are:

1. CEDEN submitted ambient water quality results and quality assurance quality control data.
2. Summary of any deviations to the QAPP or any other project deviations that impacted the quality of the Delta RMP data in order to ensure data of known and documented quality including corrective action(s).
3. Summary of dataset completeness, precision, and accuracy.
4. A list and description of all sample comparisons or tests that did not meet minimum test acceptability criteria for analyses or were considered invalid.
5. POTW and MS4 urban runoff source results and quality assurance quality control data in CEDEN reporting format.
6. Concentration vs. distance from discharge data plots for each gradient location and each constituent.
7. Mass flux vs. distance from discharge data plots for each gradient location and each constituent.
8. Evaluate mass balance and in cases where inputs are not equal to outputs, provide an estimate of the error and unmeasured sources and sinks.
9. Identification of the monitoring location where attenuation is observed for each constituent. Two metrics will be used to identify this location: a) where receiving water concentrations return to background concentrations or b) where a negative change in concentration is observed from the previous monitoring locations. Additionally, there may be a finding that attenuation was not observed in the study area. The Statewide CEC Pilot Study Monitoring Plan does not specify how the point of attenuation is determined so these two approaches provide a means to make an assessment. Additional attenuation determination methodologies may be developed.
10. Estimate of the contribution of attenuation caused by hydraulic dilution in study area, if any.

11. Provide a list and brief description of the unmeasured variables, field observations, and/or potential conditions that may influence CEC attenuation.

The Delta RMP Steering Committee and Board of Directors may further specify preparation of an overall CEC Pilot Study report for all three years of data collection. This may include more detailed assessment and interpretation of the data and data summaries provided in the Year 3 Data Report.

DATA MANAGEMENT

Study implementation will be overseen by the Delta RMP Program Manager in coordination with the CVRWQCB QA Representative. Data will be processed and managed in a CEDEN-comparable format in the CV RDC. The review of project data for compliance with the QAPP will be overseen by the Delta RMP QA Officer in accordance with the procedures reviewed and approved by the CVRWQCB QA Representative and SWRCB QA Officer which are outlined in the Data Management Standard Operating Procedures to be submitted with the QAPP.

STUDY TIMELINE AND SCHEDULE

The schedule of CEC Year 3 deliverables for FY 22-23 in **Table 16** assume that the Delta RMP Board of Directors approve the Year 3 Study Plan based on a recommendation from the Steering Committee including funding for FY 23-24 and that the Regional Water Board approves the CEC Year 3 Study Plan (part of the FY 23-24 Workplan) and Year 3 QAPP.

Table 16: CEC schedule of deliverables.

DELIVERABLE / MILESTONE	DELIVERABLE DUE DATE
Resolution Deliverables	
CEC Year 3 Study Plan [a]	May 1, 2023
CEC QAPP	May 1, 2023
Year 3 Data Report and CEDEN Deliverable [c]	February 2024
Study Design Milestones	
Year 3 Study Plan Finalized by TAC	January 2023
Year 3 Study Plan Recommended to SC	January 2023
Year 3 Study Plan Recommended to BOD	February 2023
BOD Approved Year 3 Study Plan	February 1, 2023
Recommended Implementation Schedule	
Regional Water Board-Approved Year 3 Study Plan and QAPP	August 2023
Year 3 Study Finalized Budget	June 30, 2023
Year 3 Event No. 1 [b]	August 2023 – September 2023
Year 3 Event No. 2 [b]	September 2023 – October 2023

Notes: [a] The CEC Year 3 Study Plan will be submitted to the Regional Water Board as part of the FY 23-24 Workplan due May 1, 2023.
[b] Preliminary raw data and monitoring results will be provided to the Central Valley Water Board within 60 calendar days from the date of sample analysis.
[c] Sampling and monitoring results shall be submitted within 6 months from the date of sample analysis, in a format described in the approved Data Management Plan or QAPP, and the data must go through primary quality verification and corrective actions completed, if applicable.

Appendix A: Central Valley CEC Pilot Study Work Plan

Appendix B: CEC Pilot Study Year 1 & 2 Preliminary Data Summary Report