Quality Assurance Project Plan

Pilot Study of Constituents of Emerging Concern in the Sacramento-San Joaquin Delta

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Updated by MLJ Environmental

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1. Title and Approval Sheet

For

PROJECT NAME: Delta Regional Monitoring Program Pilot Study of Constituents of Emerging Concern in the Sacramento-San Joaquin Delta

Date: October 2021

NAME OF RESPONSIBLE ORGANIZATION: MLJ Environmental

1.1 Approval Signatures

Title:	Name:	Signature:	Signature Date:
CEC Project Manager / Delta RMP Technical Program Manager	Melissa Turner	DocuSigned by: Melissa Turner 9796DD915C44446...	10/14/2021
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Environmental Program Manager, CVRWQCB	Meredith Howard	DocuSigned by: Meredith Howard ACF6CE07B4CD4E5...	10/13/2021
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AMS Field Lead	Paul Salop	DocuSigned by: Paul Salop 5770F12ED7504A9...	10/14/2021
MPSL-DFW Project Manager	Wes Heim	DocuSigned by: Wes Heim 84E7113E8ADA499...	10/14/2021
Vista Analytical Lab QA Officer	Teresa Morrison	DocuSigned by: Teresa Morrison 3B7BB1D27DC2410...	10/19/2021
Physis QA Officer	Meagan Rivera	DocuSigned by: Meagan Rivera C02EDA3384C8434...	10/22/2021
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SGS-AXYS Lab QA Officer	Sean Campbell	DocuSigned by: Sean Campbell 32763EABE72D4B7...	11/4/2021

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2.3. Acronyms and Abbreviations

See **Table 2-1** for the acronyms and abbreviations used in this document.

Table 2-1. Acronyms and abbreviations.

Abbreviation	Meaning
AMS	Applied Marine Sciences
ASC	Aquatic Science Center
BOG	Bioaccumulation Oversight Group (Safe to Eat Workgroup)
CAS	Chemical Abstracts Service
CASRN	Chemical Abstracts Service Registry Number
CD3	Contaminant Data, Display and Download Tool
CEC	Constituents of Emerging Concern
CEDEN	California Environmental Data Exchange Network
COC	Chain of Custody
CRM	Certified reference material
CVRWQCB	Central Valley Regional Water Quality Control Board
DMT	Data Management Team
DO	dissolved oxygen
FNU	Formazin Nephelometric Unit, a unit for the measurement of turbidity
FY	Fiscal Year
GC-MS	Gas chromatography-mass spectrometry
GLP	Good laboratory practices
HHCB	Galaxolide, or 1,3,4,6,7,8-hexahydro-4,6,6,7,8,8,-hexamethyl-cyclopenta[g]benzopyran
ICF	ICF International
JHA	Job Hazards Analysis
LC-MS/MS	Liquid chromatography-tandem mass spectrometry
LCS	Laboratory control sample
LRM	Laboratory reference material
MCL	Maximum contaminant level
MDL	Method detection limits
MLML RDC	Moss Landing Marine Laboratories Regional Data Center
MPSL-MLML	Marine Pollution Studies Lab Moss Landing Marine Laboratories
MPSL-DFW	Marine Pollution Studies Lab California Dept. of Fish and Wildlife
MQO	Measurement quality objective
MS	Matrix spike
MSD	Matrix spike duplicate
MTL	Monitoring trigger level
MWQI	Department of Water Resources, Municipal Water Quality Investigations
ND	Non-detect

Abbreviation	Meaning
NIST	National Institute of Standards and Technology
NRCC	National Registry of Certified Chemists
NTU	Nephelometric Turbidity Unit
OSHA	Occupational Safety and Health Administration
PBDE	Polybrominated diphenyl ethers
PCB	Polychlorinated biphenyl
PFAS	Per- and Polyfluoroalkyl Substances
PFC	Perfluorinated compounds
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PPCP	Pharmaceutical and personal care product
QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RDC	Regional Data Center
RL	Reporting limit
RMP	Regional Monitoring Program
RPD	Relative percent difference
CEC SAP	CEC Sampling and Analysis Plan
SC	Steering Committee
SCCWRP	Southern California Coastal Water Research Project
SD	Standard deviation
SFEI	San Francisco Estuary Institute
SGS-AXYS	Contract laboratory; parent organization is a multinational corporation headquartered in Switzerland, formerly Société Générale de Surveillance
SOP	Standard Operating Procedures
SPOT	Stream Pollution Trends Monitoring Program
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
TAC	Technical Advisory Committee
TOC	Total organic carbon
TSS	Total suspended solids
USEPA	US Environmental Protection Agency
WWTP	Wastewater treatment plant

3. Distribution List

This document will be posted on the Delta RMP website. In addition, copies will be sent by email to:

Delta RMP CEC Subcommittee listserv, delta-rmp-cec@sfei.org

Delta RMP Technical Advisory Committee, delta-rmp-tac@sfei.org

Delta RMP Steering Committee, delta-rmp-sc@sfei.org

Paul Salop, Applied Marine Sciences, salop@amarine.com

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Katey Rein, Vista Analytical Laboratory, krein@vista-analytical.com

Mark Baker, Physis Laboratories, markbaker@physislabs.com

Chris Samatmanakit, Weck Laboratories Inc., chris.samatmanakit@wecklabs.com

Richard Grace, SGS AXYS Analytical Services Ltd., Richard.Grace@sgs.com

4. Project/Task Organization

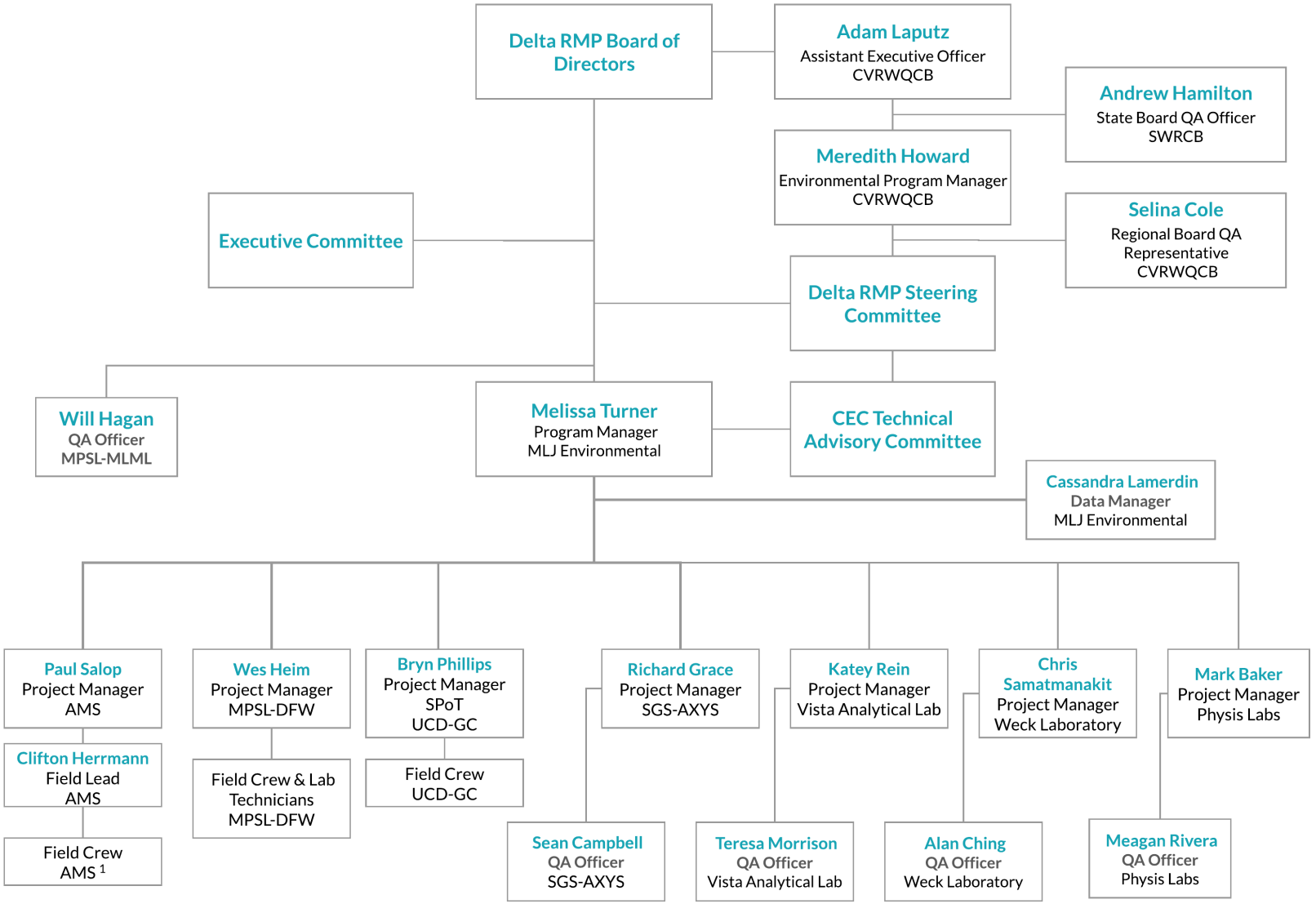
This Quality Assurance Project Plan (QA Project Plan or QAPP) has been prepared for the monitoring of Constituents of Emerging Concern (CECs) in the Sacramento-San Joaquin River Delta (the Delta) by the Delta Regional Monitoring Program (Delta RMP). The rationale and objectives for this study are described in more detail in **Section 5**, but in brief, this pilot study was designed by a Delta RMP stakeholder group (Larry Walker Associates 2018) based on the State Water Resources Control Board design guidance (Tadesse 2016) to better understand methods of evaluating ambient concentrations and sources of Constituents of Emerging Concern (CECs) in different Central Valley surface water scenarios. The pilot study is part of a statewide pilot study of a common set of CECs being conducted in different regions of California, "...to gather data to determine the occurrence and biological impacts of CEC…" and "is designed to narrow the data gap among regions by producing comparable CEC data throughout the state" (Tadesse 2016).

This section of the QA Project Plan describes how the project will be managed, organized and implemented. The responsible agency for this surface water monitoring program is Delta RMP Board of Directors (BOD) who has contracted with MLJ Environmental (MLJ) to implement this project. The program receives guidance from a Steering Committee and is advised by a Technical Advisory Committee. MLJ staff contracts with, and partners with, several agencies and laboratories to carry out monitoring activities. The QA Project Plan must be approved by the Executive Officer of the Central Valley Regional Water Quality Control Board prior to implementation.

An organizational chart, with monitoring responsibilities noted, is provided in **Figure 1**.

Detailed information on the governance of the Delta RMP, along with a roster of voting members, can be found in the program's Charter. At the time of this QAPP revision, the Delta RMP is undergoing a governance change and is in the process of updating its documentation including the Charter. This information will be updated on the Delta RMPs website once it is available; the goal is to have an updated Charter by March 2022.

Figure 1. Organization chart for the Delta RMP CEC monitoring project.



[1]AMS field crews may include staff from ICF and MLJ Environmental as needed

4.1. Principal Data Users and Stakeholders

Principal data users include internal (program participants) and external stakeholders (other Delta managers and policymakers, local scientists, and the scientific community at large, and the public). Participants include regulatory agencies, resource agencies, water suppliers, coordinated monitoring programs, wastewater treatment agencies, stormwater management agencies, irrigated agriculture coalitions, and dredgers.

4.2. Project Management

MLJ Environmental (MLJ) manages and operates the project. The CEC Project Manager (Melissa Turner) is responsible for coordinating monitoring components of this project including the organization of field sampling, interactions with the contract laboratories, and managing laboratory subcontracts. The Project Manager reports directly to the Delta RMP BOD in monthly progress reports and to the Steering Committee regarding overall progress and results at Steering Committee meetings.

The Central Valley Regional Data Center (CV RDC) Manager (Victoria Bowles) coordinates the Data Management Team (DMT), which performs data review and validation to ensure that data submitted by subcontractor laboratories are timely, complete, and properly incorporated into the Regional Data Center database. Cassandra Lamerdin will be the specific CEC Data Manager leading the DMT under the direction of the CV RDC Manager.

The Marine Pollution Studies Lab Moss Landing Marine Laboratories (MLML-MPSL) Quality Assurance Officer's (QAO, Will Hagan) role is to provide quality assurance oversight and to review and approve the quality assurance and quality control (QA/QC) procedures found in this QAPP, which include field and laboratory activities. The Project Manager in coordination with the QAO will work with the Quality Assurance Officers for contracted analytical laboratories, reviewing and communicating all QA/QC issues contained in this QAPP to the laboratories. The project QAO position is independent of data generation. Deviations to the QAPP must be approved by the Central Valley Water Board Quality Assurance Representative (Selina Cole) or the State Water Board Quality Assurance Officer (Andrew Hamilton) prior to implementation. When prior approval is not possible, the deviations must be reported to the Central Valley Water Board Quality Assurance Representative (Selina Cole) within 7 calendar days. Deviations that require approval will be stated throughout this document in the sections below.

The QAPP must be reviewed and approved by the State Water Board Quality Assurance Officer or the Central Valley Water Board's Quality Assurance Officer. Project implementation cannot occur until the QAPP is approved.

4.3. Field Crews and Laboratories

Laboratories and field crews contracted by MLJ (**Table 4-1**) will provide field sampling and analytical services and will act as logistical and technical resources to MLJ staff and management. Four types of sampling (water, fish tissue, sediment, and clam) will be carried out by three different groups (MPSL-DFW, SPoT, and AMS), with details presented below. A majority of the sampling will be performed by AMS; however, during storm events there may be a need to utilize ICF or MLJ samplers due to restrictions on AMS staff availability. For any sites AMS will sample by boat, the boat and associated boat captain will be provided by ICF. Field crews from AMS, ICF, and MLJ will be trained together to ensure consistent sampling procedures in case back up field staff from ICF and/or MLJ are needed.

Table 4-1. List of laboratories and field crews, summarizing their role

Agency or firm	Agency abbreviation	Matrix	Analytical Services	QA Manual Link
Field Sample Collection				
Applied Marine Sciences[1]	AMS	water, sediment, bivalves	Field sampling of water and sediment, clams, and field measurements	this document
Marine Pollution Studies Lab, Moss Landing Marine Labs	MPSL-DFW	fish	Fish sampling, field measurements	MPSL Laboratory QAPP, Revision 7. November 2016
UC Davis, Granite Canyon Laboratory, sampling team for the Stream Pollution Trends program	SPOT	sediment	Sediment sampling	SPOT QAPP, December 2018
Laboratory Analysis				
Vista Analytical Laboratories	Vista	water	Laboratory analysis of PFAS in water.	
Physis Laboratory	Physis	water	Laboratory analysis of galaxolide (HHBC) and triclocarban in water.	
SGS-Axys	SGS-AXYS	sediment, fish, bivalves	Laboratory analysis of PBDEs and PFAS in sediment, fish tissue and bivalve tissue.	
Weck Laboratories	Weck	water, fish, bivalves	Laboratory analysis of pharmaceuticals and personal care products (PPCPs) in water.	Weck Quality Assurance Manual, Rev 20.5, Updated 04/25/2019

[1]For sites sampled by AMS that require boat access, ICF will provide the boat and boat captain; ICF and MLJ field staff may be used in addition to AMS field staff to collect samples if needed.

Water Sampling

Water samples will be collected by AMS from twelve locations (**Table 10-1**).

Clifton Herrmann of AMS will serve as the field lead for the water collection component of this project. He will be responsible for coordinating sampling logistics, overseeing sample collection, storage, and transfer to MLJ staff for shipping to the laboratory.

A second staff member will accompany the lead on all field sampling. These personnel will be determined based on qualifications and availability, and will be chosen from among the dozen or so qualified and trained environmental analysts and scientists on staff. If necessary, ICF and/or MLJ field staff may be utilized to augment AMS field crews especially during the storm season where availability may be limited.

Fish Tissue Sampling

Fish sampling will be conducted by the Marine Pollution Studies Laboratory Dept. of Fish and Wildlife (MPSL-DFW) at Moss Landing Marine Laboratories.

Wesley Heim of MPSL-DFW will serve as the project manager for the fish monitoring component of this project. His specific duties will be to 1) review and approve the QAPP, 2) provide oversight for the collection and preparation for shipping to SGS-Axys of fish tissue samples, 3) ensure that all MPSL-DFW activities are completed within the proper timelines.

Sediment Sampling

Sediment samples will be collected by AMS and the State Water Board's Stream Pollution Trends (SPoT) Monitoring Program.

AMS staff will sample for sediment from three locations. Clifton Herrmann of AMS will serve as the field lead for the sediment collection component of this project. He will be responsible for coordinating sampling logistics, overseeing sample collection, storage, and transfer to MLJ staff for shipping to the laboratory.

A second staff member will accompany the lead on all field sampling. These personnel will be determined based on qualifications and availability, and will be chosen from among the dozen or so qualified and trained environmental analysts and scientists on staff. If necessary, ICF and/or MLJ field staff may be utilized to augment AMS field crews if there are restrictions on AMS staff availability.

The State Water Board's Stream Pollution Trends Monitoring Program (SPoT) will collect sediment for the Delta CEC monitoring project at one location that overlaps with their existing monitoring locations. This will be done in connection with an already planned SPoT cruise.

Bryn Phillips will serve as the project manager for the sediment collection component. He will be responsible for overseeing sediment sample collection, storage, and transfer to MLJ staff for shipping to the laboratory. MLJ will aid in sample collection if requested.

Clam Sampling

Clam sampling will be conducted by Applied Marine Sciences (AMS).

Clifton Herrmann of AMS will serve as the field lead for the clam collection component of this project. He will be responsible for coordinating sampling logistics, overseeing sample collection, storage, and transfer to MLJ staff for shipping to the laboratory.

Paul Salop of AMS will serve as the project manager for the clam sample collection. His specific duties will be to 1) review and approve the QAPP, 2) provide oversight, 3) ensure that all AMS activities are completed within the proper timelines.

Laboratory Analysis

Laboratories contracted by MLJ provide analytical services and will act as a technical resource to MLJ staff and management. Laboratories are listed in **Table 4-1** along with a brief description of their role in the project.

At each lab, the QA manager or equivalent will have the following specific duties: 1) review and approve the QAPP, 2) provide oversight for analyses to be done for this project, 3) ensure that all activities are completed within the proper timelines, and 4) oversee data validation, management, and reporting.

- At Vista Analytical Laboratories, Teresa Morrison is the QA Manager.
- At Weck Laboratories, the Quality Assurance Director is Alan Ching. The project manager is Chris Samatmanakit.
- At SGS-Axys Laboratories, Sean Campbell is the QA officer. The technical director is Dale Hoover. The project manager is Richard Grace.
- At Physis Labs, Meagan Rivera is the Quality Manager. The project manager is Mark Baker.

4.4. Persons Responsible for QAPP Update and Maintenance

Changes and updates to this QAPP will be made by the CEC Project Manager and the QAO, after they review the evidence for change, and must be approved by either the State Water Board QA Officer (Andrew Hamilton) or the RWQCB QA Representative (Selina Cole) prior to implementation. The CEC Project Manager in coordination with the QAO will be responsible for seeking approval from the RWQCB QA Representative or State Water Board QA Officer, making the changes, submitting drafts for review by all program participants, preparing a final

copy, and submitting the final QAPP for Central Valley Water Board Quality Assurance Representative or the State Water Board Quality Assurance Officer for approval and signatures. It is the responsibility of each signatory participant to convey and implement within their own organization any changes made in the QAPP that are applicable to their planned work.

The project plan will be reviewed on an annual basis. Changes are expected year to year in the early years of Delta RMP implementation.

5. Problem Definition/Background

This pilot study was designed by a stakeholder group to better understand methods of evaluating ambient concentrations and sources of Constituents of Emerging Concern (CECs) in different Central Valley surface water scenarios. The list of CECs is consistent with the list proposed in the State Water Board's 2016 Statewide Monitoring Plan (Tadesse 2016) and/or recommended during a May 2017 State Board workshop. This pilot study is part of a statewide pilot study of CECs being conducted in different regions of California following a mandate and guidelines by the State Water Resources Control Board (hereafter State Board). The stated goals in the statewide guidance document from the State Board (Tadesse 2016) are:

> "This statewide pilot study implements the second phase of the recommendation which is to gather data to determine the occurrence and biological impacts of CEC. The result of this pilot study will help the State Water Board to develop a statewide CEC monitoring strategy and control action."
>
> "The objective of the CEC statewide pilot study monitoring plan is to generate statewide data to inform Water Board managers of the status and trends of CECs in water. The plan is designed to narrow the data gap among regions by producing comparable CEC data throughout the state."

A work plan was developed by a Central Valley stakeholder group (Larry Walker Associates, July 2, 2018) to specifically address Section 1.1 of the statewide guidance document. Ten monitoring questions are included in the statewide guidance and the Central Valley stakeholder work plan (Table 1).

Broadly, the study follows guidance developed by a science advisory panel for monitoring CECs in California's aquatic ecosystems convened by the Southern California Coastal Water Research Project (SCCWRP). The guidance document produced contains recommendations for which compounds are the highest priority for monitoring among other considerations (Anderson et al. 2012). In addition, SCCWRP has published guidance and recommendations related to QA/QC for CEC pilot studies in California (Dodder, Mehinto, and Maruya 2015).

The State Board's purpose is to conduct pilot studies in each of the 9 regions covered by the state's 9 Regional Water Quality Control Boards. To date, pilot studies have been completed in

Region 4 (Los Angeles Region) and Region 1 (North Bay Region). The Region 4 (Los Angeles Region) pilot studies covered effluent-dominated freshwater rivers in the Los Angeles area (SCCWRP 2015). The Region 1 pilot study was conducted in California's Russian River Basin (Maruya et al. 2018).

Results of the pilot studies will be reported to the State Board for statewide comparison and to inform future assessment needs. Decisions to be made, actions to be taken, and outcomes expected from the information to be obtained will be deliberated by the State Board based on the compilation of statewide pilot studies. There are no applicable criteria or action limits necessary to the project.

6. Project/Task Description

Field crews will collect samples of surface water, bed sediment, fish, and bivalves (clams). These samples will be processed (as specified in **Section 11**) and shipped to a laboratory to be analyzed for a suite of constituents. Sample collection locations, methods and schedules are described in **Section 10**.

Required analytes - Table 6-1 shows the list of analytes, including how many samples will be collected for each analyte in each sample matrix. Water samples will be collected 4 times per year, whereas sediment, fish tissue, and clam tissue will be collected once per year.

Triclocarban is listed as a required analyte but was unable to be analyzed in year 1 due to the laboratory (Vista) indicating they were unable to do the analysis. Physis has communicated that they should be able to do the analysis; however, Physis was still finalizing the methodology at the time of this QAPP submittal. Once the method is finalized the QAPP will be revised to reflect specific MQO's associated with the analysis. The Project Manager will communicate with the CEC TAC and the CVRWQCB QA Representative if Physis is unable to finalize the method before the first sampling event, which may require a QAPP revision. All QAPP revisions will require approval and signatures.

Additional analytes - Additional constituents that are included in the laboratory's "schedule" of analytes will be reported in the data deliverable (CEDEN and appendix of results). However, the project team will not do a detailed assessment of these analytes in written reports.

Ancillary analytes - In addition to the 12 required CEC analytes in this study, samples will be analyzed for other "ancillary" analytes which are useful for interpreting the results or understanding the potential ecotoxicity of a compound in the environment. This includes parameters such as total organic carbon (TOC) and suspended sediment concentration (SSC) in water samples.

Table 6-1. Required analytes, and number of planned samples for each in year 1 of the study.

CASRN	Name	Water, (4 events, 12sites)	Sediment (1 event, 3 sites)	Bivalve Tissue (1 event, 6 sites)	Fish Tissue (1 event, 4 sites)	Note
Required Analytes						
53-16-7	Estrone	48	-	-	-	Steroid hormone; a major mammalian estrogen. Suspected to be linked also to the occurrence of feminized male fish (Ankley et al. 2017).
50-28-2	17-beta-estradiol	48	-	-	-	Also known as E2. An estrogen steroid hormone and the major female sex hormone. Affects fish reproduction even at low concentrations.
15687-27-1	Ibuprofen	48	-	-	-	Over-the-counter pain reliever. Suspected to cause harm to fish, particularly reproduction.
15307-86-5	Diclofenac	48	-	-	-	A nonsteroidal anti-inflammatory drug. Has been shown to cause kidney damage and morphological changes in kidney and intestine in fish.
1222-05-05	Galaxolide (HHCB)	48	-	-	-	Galaxolide is a high production synthetic musk used in soaps, perfumes, cosmetics, laundry detergents and shampoos, and is found at relatively high concentrations in WWTP effluents. Linked to developmental problems in invertebrates.
3380-34-5	Triclosan	48	-	-	-	An antimicrobial found in consumer products.
101-20-2	Triclocarban	48	-	-	-	An antibacterial common in personal care products like soaps and lotions. Commonly detected in wastewater, and toxic to amphibians, fish, invertebrates, and aquatic plants.

CASRN	Name	Water, (4 events, 12sites)	Sediment (1 event, 3 sites)	Bivalve Tissue (1 event, 6 sites)	Fish Tissue (1 event, 4 sites)	Note
1980-05-07	Bisphenol A	48	-	-	-	Widely used in the production of plastics. BPA affects growth, reproduction, and development in aquatic organisms and has endocrine-related effects.
5436-43-1	PBDE 047	-	3	6	4	Brominated fire retardant found in wide range of products. Highly persistent and bioaccumulative, and suspected carcinogen, endocrine disruptor, and neurotoxin.
60348-60-9	PBDE 099	-	3	6	4	Similar compound to the above. PDBEs are a mix of "congeners" or compounds with a similar chemical structure. Commercial PDBE is a mixture of different congeners, of which PDBE-47 and PDBE-99 are the most abundant.
45298-90-6/ 1763-23-1	Perfluorooctanesulfonate/Perfluorooctanesulfonic acid (PFOS)	48	3	-	4	Perfluorooctanesulfonic acid and its associated salts was the key ingredient in Scotchguard until 2003. A persistent organic pollutant and carcinogen of global concern.
45285-51-6/ 335-67-1	Perfluorooctanoate/ Perfluorooctanoic acid (PFOA)	48	3	-	4	Perfluorooctanoic acid and its associated salts is an industrial surfactant, and like PFOS, is persistent and a carcinogen.
Ancillary analytes						
none	Total Organic Carbon (TOC)	-	3	-	-	Important measurement for sediment, as ecotoxicity thresholds for contaminants are often reported in units such as micrograms per gram of organic carbon (μg/g OC).

CASRN	Name	Water, (4 events, 12sites)	Sediment (1 event, 3 sites)	Bivalve Tissue (1 event, 6 sites)	Fish Tissue (1 event, 4 sites)	Note
none	Suspended Sediment Concentration (SSC)	48	-	-	-	Measuring suspended sediment in water is important to understanding the partitioning of contaminants, as some are hydrophilic, and occur predominantly in the dissolved phase, while others are hydrophobic, and are found predominantly adsorbed to sediment particles.
Additional Analytes* - PPCPs						
57-63-6	Ethynylestradiol, 17alpha-	48	-	-	-	
57-83-0	Progesterone	48	-	-	-	
58-22-0	Testosterone	48	-	-	-	
25812-30-0	Gemfibrozil	48	-	-	-	
73334-07-3	Iopromide	48	-	-	-	
22204-53-1	Naproxen	48	-	-	-	
69-72-7	Salicylic Acid	48	-	-	-	
Additional Analytes* - PBDEs						
41318-75-6/147217-78-5	PBDE 028/33	-	3	6	4	
189084-64-8	PBDE 100	-	3	6	4	
68631-49-2	PBDE 153	-	3	6	4	
207122-15-4	PBDE 154	-	3	6	4	
207122-16-5	PBDE 183	-	3	6	4	

CASRN	Name	Water, (4 events, 12sites)	Sediment (1 event, 3 sites)	Bivalve Tissue (1 event, 6 sites)	Fish Tissue (1 event, 4 sites)	Note
1163-19-5	PBDE 209	-	3	6	4	
Additional Analytes* - PFAS						
45048-62-2	Perfluorobutanoate (PFBA)	-	3	-	4	
45167-47-3	Perfluoropentanoate (PFPeA)	-	3	-	4	
92612-52-7	Perfluorohexanoate (PFHxA)	-	3	-	4	
120885-29-2	Perfluoroheptanoate (PFHpA)	-	3	-	4	
72007-68-2	Perfluorononanoate (PFNA)	-	3	-	4	
73829-36-4	Perfluorodecanoate (PFDA)	-	3	-	4	
196859-54-8	Perfluoroundecanoate (PFUnA)	-	3	-	4	
171978-95-3	Perfluorododecanoate (PFDoA)	-	3	-	4	
862374-87-6	Perfluorotridecanoate (PFTrDA)	-	3	-	4	
365971-87-5	Perfluorotetradecanoate (PFTetrDA)	-	3	-	4	
45187-15-3	Perfluorobutanesulfonate (PFBS)	-	3	-	4	
175905-36-9	Perfluoropentanesulfonate (PFPeS)	-	3	-	4	
108427-53-8	Perfluorohexanesulfonate (PFHxS)	-	3	-	4	
146689-46-5	Perfluoroheptanesulfonate (PFHpS)	-	3	-	4	

CASRN	Name	Water, (4 events, 12sites)	Sediment (1 event, 3 sites)	Bivalve Tissue (1 event, 6 sites)	Fish Tissue (1 event, 4 sites)	Note
474511-07-4	Perfluorononanesulfonate (PFNS)	-	3	-	4	
126105-34-8	Perfluorodecanesulfonate (PFDS)	-	3	-	4	
343629-43-6	Perfluorododecanesulfonate (PFDoS)	-	3	-	4	
414911-30-1	Fluorotelomer Sulfonate, 4:2- (4:2 FTS)	-	3	-	4	
425670-75-3	Fluorotelomer Sulfonate, 6:2- (6:2 FTS)	-	3	-	4	
481071-78-7	Fluorotelomer Sulfonate, 8:2- (8:2 FTS)	-	3	-	4	
1169706-83-5	Fluorotelomer Carboxylic Acid, 3:3-(3:3 FTCA)	-	3	-	4	
1799325-94-2	Fluorotelomer Carboxylic Acid, 5:3- (5:3 FTCA)	-	3	-	4	
1799325-95-3	Fluorotelomer Carboxylic Acid, 7:3- (7:3 FTCA)	-	3	-	4	
754-91-6	Perfluorooctanesulfonamide (PFOSA)	-	3	-	4	
31506-32-8	Methyl-perfluorooctanesulfonamide, N- (MeFOSA)	-	3	-	4	
4151-50-2	Ethyl-perfluorooctanesulfonamide, N- (EtFOSA)	-	3	-	4	

CASRN	Name	Water, (4 events, 12sites)	Sediment (1 event, 3 sites)	Bivalve Tissue (1 event, 6 sites)	Fish Tissue (1 event, 4 sites)	Note
NA	Methyl Perfluorooctane Sulfonamido Acetic Acid, N- (MeFOSAA)	-	3	-	4	
NA	Ethyl Perfluorooctane Sulfonamido Acetic Acid, N- (EtFOSAA)	-	3	-	4	
24448-09-7	Methyl-perfluorooctanesulfonamidoethanol, N- (MeFOSE)	-	3	-	4	
1691-99-2	Ethyl-perfluorooctanesulfonamidoethanol, N- (EtFOSE)	-	3	-	4	
122499-17-6	Perfluoro-2-Propoxypropanoic Acid (HFPO-DA)	-	3	-	4	
39187-41-2	Perfluoro-3,6-dioxaheptanoate (NFDHA)	-	3	-	4	
1432017-36-1	Perfluoro-4-methoxybutanoate (PFMBA)	-	3	-	4	
None	Perfluoro-3-methoxypropanoate (PFMPA)	-	3	-	4	
2196242-82-5	Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid, 11- (11Cl-PF3OUdS)	-	3	-	4	

CASRN	Name	Water, (4 events, 12sites)	Sediment (1 event, 3 sites)	Bivalve Tissue (1 event, 6 sites)	Fish Tissue (1 event, 4 sites)	Note
1621485-21-9	Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9- (9Cl-PF3ONS)	-	3	-	4	
2127366-90-7	Dioxa-3H-Perfluorononanoate Acid, 4,8- (ADONA)	-	3	-	4	
220689-13-4	Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	-	3	-	4	

*Not required for this study but included as part of lab's method and to be reported by lab in the CEDEN format; additional analytes are expected to be included in the lab's data report for no additional cost. This may change from year to year.

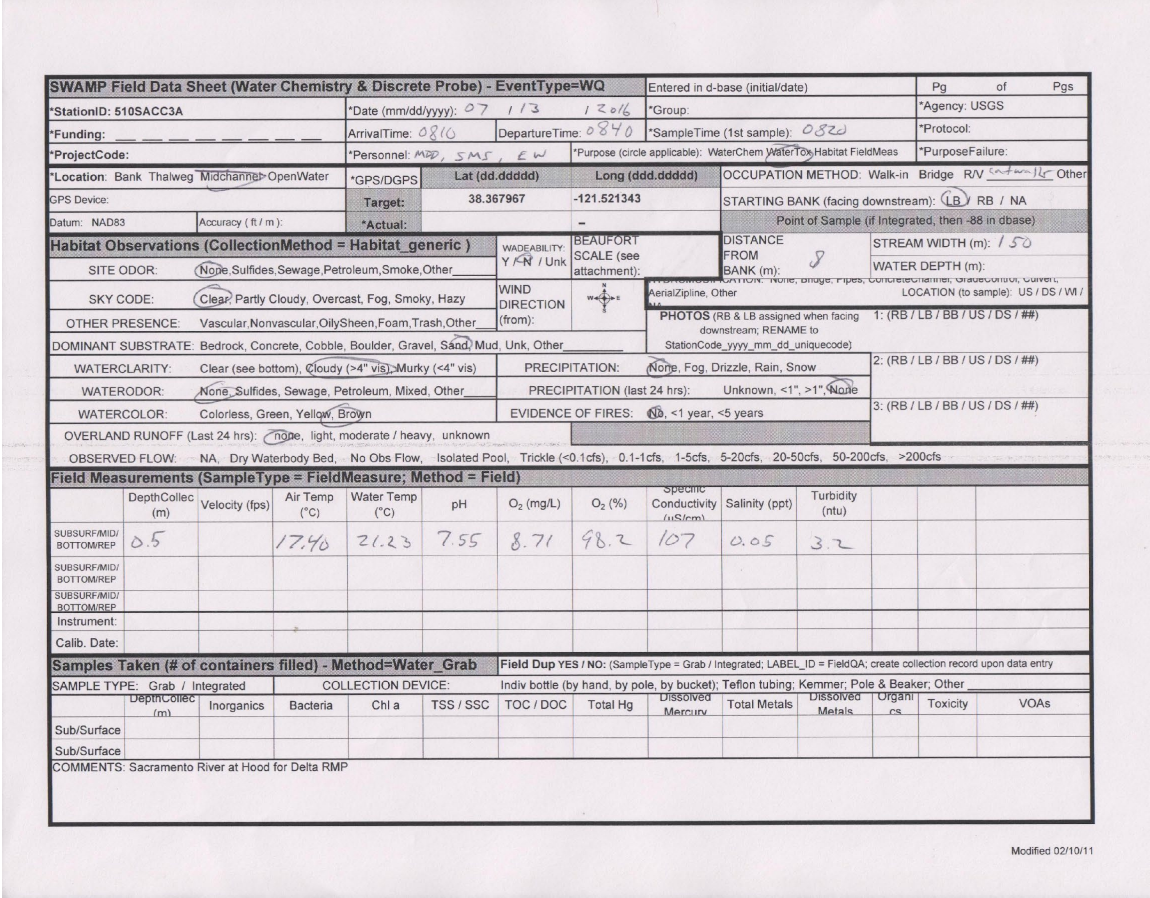
6.1. Field Measurements and Observations

When any sample (except fish) is collected, field crews will measure a standard suite of water quality parameters with a hand-held device (or devices), including:

- Oxygen, Dissolved in mg/L
- Oxygen, Dissolved as % saturation
- pH
- Specific Conductivity in µS/cm
- Temperature, °C
- Turbidity as NTU or FNU

Table 7-1 shows a schedule of expected field measurements.

See **Section 14.1** for device information. Further, field crews will fill out the standard field data form created by the Surface Water Ambient Monitoring Program (SWAMP). This form includes a number of field observations about the sampling location, the geographic setting, and habitat. An example of the form is in **Figure 2**.



SWAMP Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=WQ

Entered in d-base (initial/date) | Pg of Pgs

*StationID: 510SACC3A | *Date (mm/dd/yyyy): 07 / 13 / 2016 | *Group: | *Agency: USGS

*Funding: | ArrivalTime: 0810 | DepartureTime: 0840 | *SampleTime (1st sample): 0820 | *Protocol:

*ProjectCode: | *Personnel: MPD, SMS, EW | *Purpose (circle applicable): WaterChem WaterTox Habitat FieldMeas | *PurposeFailure:

*Location: Bank Thalweg Midchannel OpenWater | *GPS/DGPS | Lat (ddddd) | Long (ddddd) | OCCUPATION METHOD: Walk-in Bridge R/V Other

GPS Device: | Target: | 38.367967 | -121.521343 | STARTING BANK (facing downstream): LB / RB / NA

Datum: NAD83 | Accuracy (ft / m): | *Actual: | -- | Point of Sample (if Integrated, then -88 in dbase)

Habitat Observations (CollectionMethod = Habitat_generic)

SITE ODOR: None,Sulfides,Sewage,Petroleum,Smoke,Other

SKY CODE: Clear, Partly Cloudy, Overcast, Fog, Smoky, Hazy

OTHER PRESENCE: Vascular,Nonvascular,OilySheen,Foam,Trash,Other

DOMINANT SUBSTRATE: Bedrock, Concrete, Cobble, Boulder, Gravel, Sand, Mud, Unk, Other

WATERCLARITY: Clear (see bottom), Cloudy (>4" vis), Murky (<4" vis)

WATERODOR: None, Sulfides, Sewage, Petroleum, Mixed, Other

WATERCOLOR: Colorless, Green, Yellow, Brown

OVERLAND RUNOFF (Last 24 hrs): none, light, moderate / heavy, unknown

OBSERVED FLOW: NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), 0.1-1cfs, 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs

WADEABILITY: Y / N / Unk | BEAUFORT SCALE (see attachment):

WIND DIRECTION (from):

DISTANCE FROM BANK (m): 8 | STREAM WIDTH (m): 150 | WATER DEPTH (m):

AerialZipline, Other | LOCATION (to sample): US / DS / WI / NA

PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode) 1: (RB / LB / BB / US / DS / ##) 2: (RB / LB / BB / US / DS / ##) 3: (RB / LB / BB / US / DS / ##)

PRECIPITATION: None, Fog, Drizzle, Rain, Snow

PRECIPITATION (last 24 hrs): Unknown, <1", >1", None

EVIDENCE OF FIRES: No, <1 year, <5 years

Field Measurements (SampleType = FieldMeasure; Method = Field)

	DepthCollec (m)	Velocity (fps)	Air Temp (°C)	Water Temp (°C)	pH	O_2 (mg/L)	O_2 (%)	Specific Conductivity (uS/cm)	Salinity (ppt)	Turbidity (ntu)
SUBSURF/MID/ BOTTOM/REP	0.5		17.40	21.23	7.55	8.71	98.2	107	0.05	3.2
SUBSURF/MID/ BOTTOM/REP										
SUBSURF/MID/ BOTTOM/REP										
Instrument:										
Calib. Date:										

Samples Taken (# of containers filled) - Method=Water_Grab

Field Dup YES / NO: (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

SAMPLE TYPE: Grab / Integrated | COLLECTION DEVICE: | Indiv bottle (by hand, by pole, by bucket); Teflon tubing; Kemmer; Pole & Beaker; Other

	DepthCollec (m)	Inorganics	Bacteria	Chl a	TSS / SSC	TOC / DOC	Total Hg	Dissolved Mercury	Total Metals	Dissolved Metals	Organics	Toxicity	VOAs
Sub/Surface													
Sub/Surface													

COMMENTS: Sacramento River at Hood for Delta RMP

Modified 02/10/11

Figure 2. Example SWAMP field data sheet

The field crew collecting samples will make a number of observations about the sampling location, and record these on a field sampling data sheet. These observations are referred to (by USGS, SWAMP and others) as "habitat parameters," even though this project is not specifically monitoring wildlife habitat. **Table 6-2** shows the elements to be recorded by field crews (except fish collections) on the SWAMP field data sheet.[1]

Field crews will submit the field sheets to the Data Management Team (DMT) to enter the information into the CV RDC via the Environmental Data Entry and Reporting Services (eDERS) system. Field sheet data entry will be double checked by a second person and sample information confirmed with the Chain of Custody form. Field sheets will be submitted to the RWQCB QA Representative within 60 calendar days from the date of sample analysis.

Table 6-2. Habitat parameters recorded by field crews at each sampling location.

Parameter	Possible responses*
Site odor	None, Sulfides, Sewage, Petroleum, Smoke, Other

[1] https://drive.google.com/file/d/0B40pxPC5g-D0WTBmZlkzOHE0dnM/view

Parameter	Possible responses*
Sky code	Clear, Partly cloudy, Overcast, Fog, Smoky, Hazy
Other presence	Vascular, Nonvascular, Oily Sheen, Foam, Trash, Other
Dominant substrate	Bedrock, Concrete, Cobble, Boulder, Gravel, Mud, Unknown, Other
Water clarity	Clear (see bottom), Cloudy (>4" visibility), Murky (<4" visibility)
Water odor	None, Sulfides, Sewage, Petroleum, Mixed, Other
Water color	Colorless, Green, Yellow, Brown
Overland runoff (last 24 hours)	None, light, moderate/heavy, unknown
Observed flow	NA, Dry Waterbody bed, No Observed Flow, Isolated Pool, Trickle (<0.1 cfs), 0.1 - 1 cfs, 1-5cfs, 5-20 cfs, 20-50cfs, 50-200cfs, >200cfs
Wadeability	Yes, No, Unknown
Wind speed (Beaufort scale)**	0–12
Wind direction (from)	N, S, E, W, NW, NE, SW, SE
Precipitation (at time of sampling)	None, Fog, Drizzle, Rain, Snow
Precipitation (last 24 hours)	Unknown, <1", >1"
Occupation Method	Walk-in, Bridge, Other
Starting bank (facing downstream)	Left bank, Right bank, Not applicable
Distance from bank (m)	
Stream width (m)	
Water depth (m)	
Location	Bank Thalweg, Mid-channel, Open Water
Hydromodification	None, Bridge, Pipes, Concrete channel, Grade control, Culvert, Aerial zipline, Other

*Note: Parameter values shown here are approximations of CEDEN's controlled vocabulary for AnalyteName vocabulary term for habitat results. This table shows how the term is referred to on the field data sheets, with "Possible responses" field seems to be actual example values from the controlled vocab lookup list for the habitat observations VariableResult field.

**The Beaufort scale is a semi-quantitative measure of wind speed that has been in use since the 1800s. It is based on observing the effects of wind on sea or land, rather than an actual measurement of wind speed. See https://www.spc.noaa.gov/faq/tornado/beaufort.html

6.2. Fish Tissue

If possible, field crews at the Moss Landing Marine Laboratories (MPSL-DFW) will coordinate fish tissue sample collection with the Delta RMP mercury monitoring effort. Note that the MPSL-DFW crew will be collecting fish tissue only, not bivalves, water or sediment samples.

The California CEC pilot study guidance document (Dodder, Mehinto, and Maruya 2015, 29–30) says: "Candidate fish species will vary in availability by location. Species that exhibit high spatial fidelity and are suspected to accumulate relatively high levels of PBDEs and PFAS shall be selected for monitoring. [...] Fish will be individuals (provided enough sample mass is available) or composites, and bivalves shall be composites. Only specimens of the same species shall be composited together. Whole bodies for small fish, and filets of larger fish shall be analyzed. The final selection of sentinel species shall be made in coordination with SWAMP/BOG."

For organics (which most CECs are), SWAMP/BOG statewide monitoring targets bottom-feeding fish that also tend to be higher in lipid content. The target species for this study are:

- Common carp, *Cyprinus carpio*
- White catfish, *Ameiurus catus*
- Channel catfish, *Ictalurus punctatus*
- Brown bullhead, *Ameiurus nebulosus*
- Sacramento sucker, *Catostomus occidentalis*

It is desirable to collect the same species (or similar species) at each of the sites, yet it is difficult to predict what the field crew will catch. The field team will "keep what they catch" from among the project list of target species, up to a maximum of 5 fish from each species found at a given site. The sampling goal is to target fish large enough to collect muscle filet samples. Target range for fish will be from 30 to 50 cm total length, but fish of any size can be used in the analysis (as available). After every site is visited, a decision on which species to analyze will be made, with the aim of analyzing the species most common across all sites. Fish tissue samples shall be composited from a single species at each site. The staff at MPSL-DFW shall freeze the fish they have caught, report the numbers of each fish species collected at each location, and consult with the Delta RMP CEC TAC before proceeding with fish tissue compositing. This shall be done quickly after sampling, so that hold times are met (see **Table 12-1** for hold times and storage requirements).

Fish will be collected within 1 km of the targeted site latitude/longitude, as long as they do not move into a different water body, or there is a noticeable change in habitat or water quality (see **Section 10.1**).

Methods for handling fish tissue are similar to the methods used in the Russian River CEC pilot study (Maruya et al. 2018). The methods described here are also consistent with previous statewide fish surveys conducted in California (Melwani et al. 2008), SWAMP statewide bioaccumulation projects (2006-present) and with USEPA national guidance [USEPA 2000].

Field crews will put fish on wet ice in the field, and frozen within 48 hours of collection. Fish will be processed at the laboratory in Moss Landing. Dissection and compositing of fish tissue samples will be performed following MPSL-105. We consider these "larger fish" under the California CEC guidance, so fish will be dissected skin-off and only the fillet muscle tissue will be used for analysis. Fillet tissue is analyzed because muscle is the most appropriate tissue for evaluating human health risks due to fish consumption. Fish monitoring across California focuses on fillets (USEPA 2000), Dodder et al. (2015) recommends using fillets of sport fish, and prior CEC studies (RMP, Russian River) have analyzed fillets. Whole body or liver tissue are better for evaluating risks to the fish themselves, but when faced with having to select one tissue, fillet is the best option. Fish tissue samples will be shipped overnight in coolers with ice packs (preferred) or with double bagged wet ice and stored frozen in the dark in clean amber glass jars with screw caps at -20°C prior to analysis.

6.3. Clam Tissue

Clam tissue will be collected and processed as described in **Section 11.4** and analyzed for two PBDE congeners. We do not plan to analyze clam tissue for PFOS or PFOA. Monitoring in San Francisco Bay has found that concentrations in bivalves for these compounds are typically below method detection limits (Rebecca Sutton, SFEI-ASC Senior Scientist, personal communication). The decision to not analyze PFAS in clams was made with stakeholder input. Information about PFAS monitoring in SF Bay bivalves is included in section 2.2 and Appendix table 4 of the Bay RMP PFAS Synthesis and Strategy document.

Clams will be sampled annually during the summer months, for 2 years from the 6 stations listed in **Table 10-1**, if clams can be found at each site. Required analytes for clam tissue are PBDE 047 and 099 (**Table 6-1**). Composites will be formed using at least 20 individual clams; field crews may deem it necessary to increase the number of clams in the aliquot to achieve a sufficient mass to satisfy laboratory requirements, as outlined in **Section 11.4**.

According to the state guidance on CEC monitoring, candidate bivalve species are *Corbicula fluminea* (freshwater) and *Mytilus spp. (californianus or galloprovincialis)* for embayment and marine habitats. The San Francisco Bay RMP has collected and monitored constituents in bivalve samples, including *Corbicula*, at the two DRMP stations at the confluence of the Sacramento and San Joaquin Rivers, as recently as July 2018. *Corbicula fluminea* (**Figure 3***)* is the freshwater bivalve species present in the Delta (*Mytilus spp.* are confined to saltwater), and has been the subject of past bioaccumulation studies.

Figure 3. Asian clam, Corbicula fluminea. Photo 2006, USGS.

6.4. Water

Grab samples will be collected at 12 locations throughout the Delta (**Table 10-1**) with the goal of collecting samples mid-stream to capture water from a well-mixed zone; the table indicates the preferred collection location based on sampling that was performed in Year 1. Whole (unfiltered) water samples will be analyzed for concentrations of constituents in Delta waterways; CECs partitioning to solids will be measured in sediment. Water samples will be collected by either boat or by shore access at all 12 locations by field crews from AMS; field crews will follow the water grab sampling protocols outlined in the AMS CEC Sampling and Analysis Plan (CEC SAP), referenced in **Table 9-1**. For samples collected by boat, samples will be collected following similar protocols used by DWR in Year 1. According to the DWR SOP (p. 10): "Samples should be collected at the point in the channel cross-section where water is flowing and appears to be well mixed and is at least 1-meter deep. The boat should be positioned so that the sample intake is upstream of the boat motor."

6.5. Sediment

Bed sediment samples will be collected at the two wadeable stream locations (Dry Creek and Old Alamo Creek) by AMS field crews, and at one larger riverine location (American River at Discovery Park) by the State Water Board's Stream Pollution Trends Monitoring Program (SPoT).

In addition to the required analytes, bed sediment samples will be analyzed for total organic carbon (TOC).

Although grain size is sometimes a useful factor for understanding variations in sediment concentrations among sites and samples, for a screening study, in Year 1 SFEI-ASC scientists did not feel that measurement of grain size is necessary yet; therefore, we have not included this in the study design.

Field crews will record observations about the sediment sample on the field data sheet; for example, if the sediment is sandy, silty, contains shells, etc.

7. Quality Objectives and Criteria

As described in **Section 6** above, this study of CECs in the Delta is a screening study, and the first of its kind for many of the water quality analytes in the region. The purpose is to answer the study monitoring questions related to the presence, attenuation, and relative source contributions of CECs in the Central Valley. This includes an assessment of how environmental concentrations compare to the monitoring trigger quotients (MTQs) specified in the Statewide Guidance. Therefore, method detection limits shall be low enough to detect analytes at ecologically important levels, e.g. less than a relevant ecotoxicological threshold. The goals of this study do not include developing robust estimates of the average concentration in a region, or the distribution of concentrations, nor is it intended to estimate trends in concentrations over time.

7.1. Data Quality Objectives

This study has been designed following guidance in the document *Monitoring of Constituents of Emerging Concern (CECs) in California's Aquatic Ecosystems – Pilot Study Design and QA/QC Guidance* (Dodder, Mehinto, and Maruya 2015). That report provided the rationale, design framework, and recommended QA/QC for the statewide survey project, with the stated goals being to:

1) verify the occurrence of high priority CECs in aqueous, sediment and tissue samples;
2) initiate compilation of a data set that characterizes their occurrence in source and receiving waters, and in appropriate matrices (i.e., water, sediment and tissue);
3) evaluate improved/supplemental methods and surrogate measures (e.g., bioanalytical screening tools); and
4) utilize, modify and/or initiate development of environmental fate models where appropriate.

This current portion of the project addresses the first two goals, following the statewide guidance to provide comparable data among regions, where currently there is sporadic monitoring for CECs. Finding of these CECs will provide rationale for continued or intensified monitoring, or their absence will reduce monitoring of some chemicals in favor of other CECs.

Results of this study will be compared to the monitoring trigger levels (MTLs) proposed by Dodder et al. and other risk or effects thresholds to decide what, if any, future monitoring is warranted.

The Dodder et al. document provides recommendations for MTLs [2] and reporting limits (RL) for water sampling most of the constituents under consideration here. However, Dodder et al. provided recommended MTLs and RLs only for fipronil in sediment, and for PBDEs and PFAS in tissue.

As detailed in **Section 5**, the objective of the Delta RMP CEC Pilot Study is to better understand the occurrence of Constituents of Emerging Concern (CECs) in the Sacramento-San Joaquin Delta. There are currently no regulatory data quality objectives for this study, as there are no established water quality criteria for most of the included analytes. However, this study has been designed to fulfill the requirements of a state regulatory agency.

Absent any regulatory thresholds, the target RLs presented below are derived to assess whether measured environmental concentrations are above or below monitoring trigger levels (MTL), as identified in Dodder 2015. RLs are thus set at half the MTL, with target minimum detection limits set at or below the RL. Prior to the initial analyses of samples for the project, each laboratory will provide documentation that sample analyses can be performed within the measurement quality objectives listed in the QAPP. Required on-going QC samples are detailed in **Table 14-2** with their associated Measurement Quality Objectives (MQO). MQOs are the same for all matrices and parameters. If a QC sample does not meet the MQO for a parameter, possible causes of the failure will be discussed with the lab. If the cause of the problem cannot be identified, or reanalysis is not possible (e.g. past hold time, insufficient material, etc.), all samples for that matrix and parameter will be flagged as per the procedures in **Section 22** and the CVRWQCB QA Representative will be informed of these issues within 7 calendar days.

7.2. Data Quality Indicators

Data Quality Indicators (DQIs) are the quantitative measures and qualitative descriptors used to set limits of acceptable levels of data error. The principal data quality indicators are precision, accuracy/bias, comparability, completeness, and representativeness. How each indicator will be evaluated for field measurements and laboratory analyses is detailed in sections **7.3.1** and **7.4.1**.

- **Precision** describes how close the agreement is between multiple measurements.

[2] Monitoring Trigger Quotient (MTQ) = monitoring trigger level (MTL) divided by measured environmental concentration (MEC)

- **Accuracy** is the assessment of the closeness of agreement between a measured or determined value and the true value. Bias is the quantitative measure of the difference between those values.
- **Comparability** expresses the measure of confidence that one dataset can be compared to and combined with another for a decision(s) to be made (US EPA QA/G-5 2002).
- **Completeness** refers to the comparison between the amount of valid data originally planned to be collected, and the actual quantity collected (US EPA QA/G-5 2002).
- **Representativeness** is the degree to which measurements correctly represent the environmental condition, target organism population, and/or watershed to be studied (US EPA QA/G-5 2002).
- **Sensitivity** is the ability of a measurement to detect small quantities and differences in concentration of the measured component.

7.3. Field Quality Control Measures for Sensors and Sample Collection

7.3.1. Field Measurements

Precision of field measurements is determined by repeated measurement of the same parameter within a single sample, or samples taken in rapid succession (only when conditions are not dynamically variable). The project will address the precision of field measurements by performing replicate measures at the required intervals described in **Section 14**, Field Measurements.

Accuracy/Bias of field measurements is established by calibration and tested by periodic measurement of known standards. The project will perform instrument calibration prior to each sampling day or event for user-calibrated instruments (e.g. daily for handheld field meters), or at the manufacturer-specified intervals for instruments requiring factory servicing or otherwise incapable of field calibration. All instruments undergo blank and calibration checks as described in **Table 14-1**. (Note that blanks are not common or possible for certain field measures such as pH, temperature, and specific conductivity.)

Completeness of field measurement is evaluated as the percentage of usable measurements out of the total number of measurements desired. The project has a goal that at least 90% of the planned field measurements are collected and are usable. If a lower percentage is achieved for any sampling event or time period, causes will be investigated and fixed where possible, through instrument maintenance (e.g. defouling), recalibration, repair, or replacement (with the same or different instrument type) as needed. If completeness targets are not achieved, instrument choice, settings, deployment method, maintenance, and/or other activities shall be

adjusted to improve measurement reliability before the next sampling event or measurement period.

Comparability of field measurements will be ensured by using protocols and QA standards that are comparable within the project and to similar monitoring projects in the study area.

Representativeness of field measurements will be ensured by utilizing standardized protocols and selecting representative monitoring sites and underway paths to support the project goals (**Section 5**). Conditions that will influence the measurements will be noted in the database and measurements will be retaken if necessary.

Sensitivity is most commonly defined as the lowest value an instrument or method can measure with reasonable statistical certainty as well as the ability of the instrument to detect small changes. Where applicable, the desired sensitivity is expressed as a target detection limit and resolution of a deployed sensor. For this project, sensors will be used that meet the data quality objectives.

Table 7-1. Schedule of field measurements.

Field Agency	Sample Matrices	# of Sampling Locations				Total # of Measurements
		Event 1	Event 2	Event 3	Event 4	
AMS	Water only	4	12	12	12	40
	Water/Sediment	2	-	-	-	2
	Water/Bivalves	6	-	-	-	6
MPSL-DFW	Fish only	4	-	-	-	4
SPoT	Sediment only	1	-	-	-	1
Grand Total						**53**

7.3.2. Field Sample Collection

For this CECs study, field duplicates and field blanks will be obtained, distributed across events or/and sampling crews and sites. Minimum frequencies and target performance requirements for field blanks and field replicates are described in **Table 7-4**.

Precision of the field sample collection will be evaluated by collecting field duplicates/replicates for water and sediment samples; such samples are not possible for tissue samples, as tissue samples are composed of discrete individual organisms as opposed to a continuum from which a subsample is drawn. Duplicate or replicate samples account for variability in the field collection and laboratory analysis combined and are collected at the same time under the same conditions as the original sample. Different ways of collecting replicate field samples are

possible and include different factors contributing to sample variability. For the purposes of this project, we use the following terminology:

- Field replicate - these do not have a separate code or definition in CEDEN, and just maintain the same SampleType (e.g., Grab, Integrated), incrementing in Replicate count. For this project we use "field replicate" to indicate separate samples collected from the field for a given site and event. These capture not just the heterogeneity of subsampling or splitting the sample matrix, but also the spatial and temporal variation in collection within a given site for a collection event. Sequential filling of sample bottles (if separated by >1 minute in collection time) is considered a field replicate rather than a field split. Similarly, reloading and redeploying a sampler rosette would yield field replicates; however, all the bottles on the rosette for each given deployment would be considered field splits of each other.

Minimum frequencies and target performance requirements for field duplicates/replicates are described in **Table 7-4**.

Where samples are collected by different field crews, or personnel varies, field blanks and field duplicates shall be spread among different crews. Where samples are collected by a single field crew, field QC samples should be spread among sites or/and events as possible.

Contamination. In the field, contamination of field samples can be introduced by sampling equipment or personnel during field sample collection, in addition to any contamination already present in the sampling container or blank water used. Naming conventions for blanks will differ among projects, so here we define their usage for this project based upon CEDEN descriptions.

- Bottle blank - in CEDEN: "An analyte-free water sample prepared in the laboratory and used to evaluate potential contamination due to sample container or laboratory cleaning methods."

- Travel blanks - in CEDEN: "Clean water transported to site, handled like sample (never opened), and returned to laboratory for analysis". These account for constituents introduced during the transport process between the laboratory and field site, in addition to any contamination from the source solution and container.

- Field (ambient) blank - in CEDEN: "Clean water taken to field, transferred to container, preserved (if appropriate) and treated same as corresponding sample type during the sampling event." These add exposure to the field sampling environment, in addition to those included in travel blanks. The "treated same as" part of the description is interpreted for the purposes of the Delta RMP as applying to steps only after the blank is

in the container (i.e., not exposed to or transferred by field sampling equipment). Field blanks collected using field equipment are instead listed as "(field) equipment blanks" (defined below).

- Equipment blank - in CEDEN: "Clean water pumped through new equipment, cleaned equipment after contamination, equipment for non-surface water, new lot of filters (metals), preserved (if appl.) and analyzed". CEDEN instructs to note in the comments field the equipment type and whether these are done in the lab or field. These account for contamination introduced by the sampling equipment, and possibly field ambient conditions (if generated in the field).

To collect the field blank, reagent grade water provided by the analytical lab, shall be transferred into a sample container provided by the analytical laboratory using the usual collection equipment and treated the same as field samples. Weck, Vista, and Physis will provide reagent water.

Any (field) equipment blanks for equipment used a single time within an event can be collected at any point during sample collection, but ensure the sample is collected using cleaned or new equipment. For equipment used for multiple sites before replacement or recleaning at a lab, equipment will be field cleaned or flushed as usual between sites, except where site water is normally used, using blank water instead.

Neither bottle blanks, travel blanks, **nor** (lab or field-generated) equipment blanks are required as part of this project at the present time. At the discretion of the Project QAO or at the request of the State Board QAO, these samples may be reinstated in the future, for example when an established procedure is changed or when contamination problems are identified, to help deduce the specific cause of any field blank contamination found. In some cases, field-generated equipment blanks may be substituted for field blanks, but must be approved by the Delta RMP PM and QAO.

Accuracy. Field blank or equipment blank contamination discussed previously will also affect the accuracy of measurements, usually causing a high bias in reported concentrations. Matrix interference by various environmental substances will also cause high biases (by being mistaken for target compounds) or low biases (by competition for or consumption of reagents, or attenuating measured signals). Similarly biotic and abiotic reactions in the sample due to improper preservation and/or extended storage will cause loss of some target analytes, or generation of others (e.g. metabolites or degradates). Field blanks and matrix spikes can be routinely collected to identify and quantify some of those field-related causes of biases; diagnosing these other possible sources of inaccuracy generally requires special method

development studies designed to test the importance of specific factors (e.g., different holding time conditions or durations, amounts and types of preservatives added).

Representativeness. The Central Valley CEC Pilot Study was designed with a goal of assessing the concentrations of important emerging constituents in surface waters of the Sacramento-San Joaquin Delta. The goal is to take measurements of contaminant concentrations across time and space as representative as possible of conditions in the Delta or just upstream, within financial and logistical constraints. For example, sampling locations (**Table 10-1**) were selected that represent both major rivers in the Delta (Sacramento and San Joaquin Rivers), and tributaries that will contribute pollutant loading from urban areas and wastewater treatment plants. Water sampling will be conducted four times per year in both wet weather and dry weather (**Table 10-2** and **Table 10-3**) to determine how contaminant concentrations will vary by season and in response to rainfall and runoff.

Project scientists will assess the representativeness of CEC concentrations measured in the Delta, based on the results from the first year of sampling, and with the use of maps, charts, and other methods of exploratory data analysis. It will be appropriate to adjust sampling location or timing in order to achieve greater representativeness. Any proposed changes to the study will be made in collaboration with the Delta RMP Technical Advisory Committee and CEC Subcommittee.

7.4. Laboratory Quality Control Measurements

The discussion in this section reviews the measurements and procedures expected to demonstrate the quality of reported data. **Table 7-2** provides an overview of quality control (QC) sample types and their purpose. **Section 7.4.1** discusses how laboratory QC samples will be assessed. **Section 0** provides a listing of which laboratory QC samples are required. **Table 7-3** summarizes the target reporting limits (RL) and method detection limits (MDL) for all laboratory measurements.

Table 7-2. Purposes of field and laboratory QC sample types and data quality indicators applicable to the Delta RMP.

QC Sample Type	Data Quality Indicator/Purpose
Field Sampling QA	
Field Blanks	Identify contamination resulting from field conditions (bias from field conditions)
Field Duplicates	Document the precision of the sampling and analysis process
Trip Blank	"A trip blank (usually only used for VOCs) is designed to measure cross-contamination that may occur during sample handling and transport (e.g., from a broken bottle in the sample ice chest)" (Baylor et al. 2014)

QC Sample Type	Data Quality Indicator/Purpose
Laboratory QA	
Laboratory Blanks	Assess potential sample contamination, confirm the absence of analytes introduced throughout the sample preparation and analysis process. Also sometimes referred to as "Method Blanks." Bias from laboratory procedures.
Laboratory Duplicates or Laboratory Replicates	Assess analytical precision, through replicate sub-samples of field samples (preferred), taken through the full analytical procedure including all lab processes combined. Although certified reference materials, lab reference materials, matrix spike samples, or laboratory control samples can also be analyzed in duplicate, they are referred to prefaced with their sample type, e.g., "matrix spike duplicate"
Laboratory Control Samples	Assess analytical accuracy, in samples containing known amounts of target analytes, analyzed much like an ordinary field sample. Primarily used for lab created clean or null matrix samples spiked with target analytes. See "lab reference material" for natural matrix samples
Laboratory Reference Materials	Assess accuracy within an analytical batch and precision across analytical batches in natural matrix samples. "Lab Reference Material" is used for natural matrix recovery samples without certified values, but with known expected values (e.g., archived homogenized collected material previously analyzed, diluted CRMs).
Certified Reference Materials	Assess accuracy within an analytical batch and precision across analytical batches in natural matrix samples. Certified reference materials (CRMs) have externally validated expected "certified" concentrations of analytes of interest, and are obtained from commercial or government vendors (e.g., NIST, which calls them "SRMs" (standard reference materials)).
Matrix Spikes (MS)/Matrix Spike Duplicates (MSD)	Accuracy and precision/evaluate the effect of the sample matrix on the recovery of the compound(s) of interest and providing an estimate of analytical precision when measured in duplicate (laboratory chemical analysis).
Surrogate Spikes	Accuracy of analytical method/assess the efficiency of the extraction method for organic analytes (laboratory chemical analysis).
Internal Standards	Accuracy of analytical method/enable optimal quantitation, particularly of complex extracts subject to retention time shifts or instrument interferences relative to the analysis of standards. Internal standards can also be used to detect and correct for problems in the injection port or other parts of the instrument (laboratory chemical analysis).

The quality assessment process that is used after the data have been collected to evaluate whether the data quality objectives have been satisfied is described and illustrated in **Section 22, Data Review, Verification, and Validation**.

7.4.1. Laboratory QC Measurements

Accuracy is the assessment of the closeness of agreement between a measured or determined value and the true value. Blank spikes (laboratory control samples or LCSs), matrix spikes/matrix spike duplicates (MSs/MSDs), and internal standards or surrogate recoveries (as applicable for the method), will be employed to evaluate accuracy of results. Accuracy shall be measured as a percent recovery. For a matrix spike, a known quantity of an analyte added to a sample to test whether the response to a sample is the same as that expected from a calibration curve. These samples are useful for determining whether elements of the matrix (the remainder of the sample other than the analyte) influence the results of the measurement. The percent recovery for matrix spike samples is calculated using the equation:

$$\%\,recovery = \frac{\left(C_{spiked\ sample} - C_{unspiked\ sample}\right)}{C_{added}} \times 100$$

The percent recovery for LCS and surrogates is calculated using the equation:

$$\%\,recovery = \frac{analyzed\ concentration\ of\ LCS\ or\ surrogate}{certified\ concentration\ of\ LCS\ or\ surrogate} \times 100$$

All recovery samples for all matrices and parameters will be evaluated for accuracy using the measurement quality objectives listed in **Table 14-2**.

Sensitivity refers to the capability of a method or instrument to detect a given analyte at a given concentration and reliably quantitate the analyte at that concentration. This project will achieve the desired sensitivity by selecting appropriate analytical methods and the laboratory will demonstrate analytical capability to meet the project data quality objectives and RLs.

Table 7-3 shows each contract laboratory's method detection limits for the target analytes, along with the recommended monitoring trigger levels in Dodder et al. (2015). **Precision** is the reproducibility of an analytical measure. Laboratory duplicate analyses of field samples and matrix spikes will be used to assess precision using calculated relative percent differences (RPD) or relative standard deviation (RSD). RPD is calculated as:

$$RPD = \frac{|X_1 - X_2|}{\left(\frac{X_1 + X_2}{2}\right)} \times 100$$

where X_1 and X_2 are independent measurements of the replicate samples.

If more than two replicate samples are collected, the relative standard deviation (RSD) shall be used as a basis of comparison against the MQOs:

$$RSD = [STDEV(all\ replicate\ samples) \div AVERAGE\ (all\ replicate\ samples)] \times 100$$

All duplicates analyses will be evaluated for precision using the measurement quality objectives listed in **Table 14-2**.

Completeness is defined as "a measure of the amount of data collected from a measurement process compared to the amount that was expected to be obtained under the conditions of measurement" (Stanley and Verner 1985). The goal of the Delta RMP is to achieve >90% completeness for all analyses.

Completeness will be quantified as the total number of usable (non-rejected) results divided by the total number of expected results. Completeness statistics will be aggregated by all analytes of interest for a given laboratory or type of analysis, subset by matrix. However, additional factors will be considered on a case-by-case basis.

Contamination. Laboratory method blanks (also called extraction blanks, procedural blanks, or preparation blanks) are used to assess laboratory contamination during all stages of sample preparation and analysis. Method blanks shall contain analyte concentrations less than the MDL. A method blank concentration > MDL for any analytes of interest will require corrective action (e.g., checking of reagents, re-cleaning and re-checking of equipment) to identify and eliminate the source(s) of contamination before proceeding with sample analysis. If eliminating the blank contamination and reanalysis is not possible, results for all impacted analytes in the analytical batch[3] shall be flagged. In addition, a detailed description of the contamination sources and the steps taken to identify and eliminate/minimize them shall be included in the transmittal letter. Reported results will be blank-subtracted, only if described in the method and/or laboratory SOP employed and approved by the QA Officer. Currently (July 2020), none of the listed laboratory methods employ blank-subtraction.

Comparability. Whenever possible the Delta RMP adheres to the requirements specified in the SWAMP Quality Assurance Program Plan (QAPrP), for parameters covered by the SWAMP Quality Control and Sample Handling Tables, to facilitate coordination and data integration with other water quality monitoring efforts. Specifically, the Delta RMP adheres to SWAMP requirements for QC and holding times and to California Environmental Data Exchange Network (CEDEN) requirements for data submittal.

[3] A group of samples, including quality control samples, which are processed together using the same method, the same lots of reagents, and at the same time or in continuous, sequential time periods. Samples in each batch shall be of similar composition and share common internal quality control standards. For this project an analytical batch shall contain no more than 20 field samples.

Table 7-3. Method detection limits for chemical analytes.

Matrix / Analyte Type	Analyte	CEDEN Matrix Code	Mon Trigger Level (MTL)	Target RL (1/2 MTL)	MDL	RL	Units	Lab	Method
			Water						
Required	Estrone	samplewater	6.0	3.0	10	10	ng/L	Weck	Hormones by LCMSMS-APCI+ by EPA 1694M-APCI
Required	17-beta-estradiol	samplewater	2.0	1.0	10	10	ng/L	Weck	Hormones by LCMSMS-APCI+ by EPA 1694M-APCI
Required	Ibuprofen	samplewater	100	50	5	10	ng/L	Weck	Pharmaceuticals by LCMSMS-ESI- by EPA 1694M-ESI-
Required	Diclofenac	samplewater	100	50	0.26	10	ng/L	Weck	Pharmaceuticals by LCMSMS-ESI- by EPA 1694M-ESI-
Required	Galaxolide (HHCB)	samplewater	700	350	0.1	1	ng/L	Physis	EPA 625.1M
Required	Triclosan	samplewater	250	125	10	10	ng/L	Weck	Pharmaceuticals by LCMSMS-ESI- by EPA 1694M-ESI-
Required	Triclocarban	samplewater	-	-	TBD[1]	TBD[1]	ng/L	Physis	EPA 625.1M
Required	Bisphenol A	samplewater	60	30	2	10	ng/L	Weck	Pharmaceuticals by LCMSMS-ESI- by EPA 1694M-ESI-
Ancillary	Suspended Sediment Concentration	samplewater	n/a	n/a	3.1	5	mg/L	Weck	MPSL-108
Required	Perfluorooctanesulfonic acid	samplewater	none listed	n/a	NA[2]	2	ng/L	Vista	Modified EPA 537M
Required	Perfluorooctanoic acid	samplewater	none listed	1	NA[2]	2	ng/L	Vista	Modified EPA 537M

Matrix / Analyte Type	Analyte	CEDEN Matrix Code	Mon Trigger Level (MTL)	Target RL (1/2 MTL)	MDL	RL	Units	Lab	Method
Additional	Ethynylestradiol, 17alpha-	samplewater	-	-	10	10	ng/L	Weck	Hormones by LCMSMS-APCI+ by EPA 1694M-APCI
Additional	Progesterone	samplewater	-	-	10	10	ng/L	Weck	Hormones by LCMSMS-APCI+ by EPA 1694M-APCI
Additional	Testosterone	samplewater	-	-	10	10	ng/L	Weck	Hormones by LCMSMS-APCI+ by EPA 1694M-APCI
Additional	Gemfibrozil	sample water	-	-	0.08	10	ng/L	Weck	Pharmaceuticals by LCMSMS-ESI- by EPA 1694M-ESI-
Additional	Iopromide	samplewater	-	-	1.8	50	ng/L	Weck	Pharmaceuticals by LCMSMS-ESI- by EPA 1694M-ESI-
Additional	Naproxen	samplewater	-	-	2	10	ng/L	Weck	Pharmaceuticals by LCMSMS-ESI- by EPA 1694M-ESI-
Additional	Salicylic Acid	samplewater	-	-	0.86	500	ng/L	Weck	Pharmaceuticals by LCMSMS-ESI- by EPA 1694M-ESI-
Sediment									
Required	PBDE047[3]	sediment	-	-	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Required	PBDE099[3]	sediment	-	-	NA[2]	0.005[4]	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Required	Perfluorooctanesulfonate[5]	sediment	-	-	NA[4]	0.016	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Required	Perfluorooctanoate[5]	sediment	-	-	NA[4]	0.016	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	PBDE 028/33	sediment	-	-	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Additional	PBDE 100	sediment	-	-	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6

Matrix / Analyte Type	Analyte	CEDEN Matrix Code	Mon Trigger Level (MTL)	Target RL (1/2 MTL)	MDL	RL	Units	Lab	Method
Additional	PBDE 153	sediment	-	-	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Additional	PBDE 154	sediment	-	-	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Additional	PBDE 183	sediment	-	-	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Additional	PBDE 209	sediment	-	-	NA[2]	0.05	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Ancillary	Moisture	sediment	-	-	NA	NA	% ww	Axys	SGS Axys MLA-033 Rev 6
Additional	Perfluorobutanoate	sediment	-	-	NA[4]	0.64	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoropentanoate	sediment	-	-	NA[4]	0.32	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorohexanoate	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoroheptanoate	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorononanoate	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorodecanoate	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoroundecanoate	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorododecanoate	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorotridecanoate	sediment	-	-	NA[4]	0.04 0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorotetradecanoate	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorobutanesulfonate	sediment	-	-	NA[4]	0.04 0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoropentanesulfonate	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorohexanesulfonate	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoroheptanesulfonate	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorononanesulfonate	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorodecanesulfonate	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorododecanesulfonate	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Fluorotelomer Sulfonate, 4:2-	sediment	-	-	NA[4]	0.64	ng/g dw	Axys	SGS Axys MLA-110 Rev 2

Matrix / Analyte Type	Analyte	CEDEN Matrix Code	Mon Trigger Level (MTL)	Target RL (1/2 MTL)	MDL	RL	Units	Lab	Method
Additional	Fluorotelomer Sulfonate, 6:2-	sediment	-	-	NA[4]	0.64	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Fluorotelomer Sulfonate, 8:2-	sediment	-	-	NA[4]	0.64	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Fluorotelomer Carboxylic Acid, 3:3-	sediment	-	-	NA[4]	0.64	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Fluorotelomer Carboxylic Acid, 5:3-	sediment	-	-	NA[4]	4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Fluorotelomer Carboxylic Acid, 7:3-	sediment	-	-	NA[4]	4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorooctanesulfonamide	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Methyl-perfluorooctanesulfonamide, N-	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Ethyl-perfluorooctanesulfonamide, N-	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Methyl-perfluorooctanesulfonamidoethanol, N-	sediment	-	-	NA[4]	1.6	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Ethyl-perfluorooctanesulfonamidoethanol, N-	sediment	-	-	NA[4]	1.6	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoro-2-Propoxypropanoic Acid	sediment	-	-	NA[4]	0.64	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoro-3,6-dioxaheptanoate	sediment	-	-	NA[4]	0.32	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoro-4-methoxybutanoate	sediment	-	-	NA[4]	0.32	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoro-3-methoxypropanoate	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-	sediment	-	-	NA[4]	0.64	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-	sediment	-	-	NA[4]	0.64	ng/g dw	Axys	SGS Axys MLA-110 Rev 2

Matrix / Analyte Type	Analyte	CEDEN Matrix Code	Mon Trigger Level (MTL)	Target RL (1/2 MTL)	MDL	RL	Units	Lab	Method
Additional	Dioxa-3H-Perfluorononanoate Acid, 4,8-	sediment	-	-	NA[4]	0.64	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoro(2-ethoxyethane)sulfonic acid	sediment	-	-	NA[4]	0.16	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Ancillary	Moisture	sediment	-	-	NA	NA	% ww	Axys	SGS Axys MLA-110 Rev 2
Ancillary	Total Organic Carbon	sediment	-	-	36	200	mg/kg dw	Weck	EPA 9060M
Bivalve Tissue[6]									
Required	PBDE 047[3]	tissue	28.9	14.5	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Required	PBDE 099[3]	tissue	28.9	14.5	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Additional	PBDE 028/33	tissue	-	-	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Additional	PBDE 100	tissue	-	-	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Additional	PBDE 153	tissue	-	-	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Additional	PBDE 154	tissue	-	-	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Additional	PBDE 183	tissue	-	-	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Additional	PBDE 209	tissue	-	-	NA[2]	0.05	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Additional	PBDE 028/33	tissue	-	-	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Ancillary	Moisture	tissue	-	-	NA	NA	% ww	Axys	SGS Axys MLA-033 Rev 6
Ancillary	Lipid	tissue	-	-	NA	NA	% ww	Axys	SGS Axys MLA-033 Rev 6
Fish Tissue[7]									
Required	PBDE 047[3]	tissue	28.9	14.5	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Required	PBDE 099[3]	tissue	28.9	14.5	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Additional	PBDE 028/33	tissue	-	-	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Additional	PBDE 100	tissue	-	-	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Additional	PBDE 153	tissue	-	-	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Additional	PBDE 154	tissue	-	-	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6

Matrix / Analyte Type	Analyte	CEDEN Matrix Code	Mon Trigger Level (MTL)	Target RL (1/2 MTL)	MDL	RL	Units	Lab	Method
Additional	PBDE 183	tissue	-	-	NA[2]	0.005	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Additional	PBDE 209	tissue	-	-	NA[2]	0.05	ng/g dw	Axys	SGS Axys MLA-033 Rev 6
Ancillary	Moisture	tissue	-	-	NA[2]	NA	% ww	Axys	SGS Axys MLA-033 Rev 6
Ancillary	Lipid	tissue	-	-	NA	NA	% ww	Axys	SGS Axys MLA-033 Rev 6
Required	Perfluorooctanesulfonate[5]	tissue	1000	500	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Required	Perfluorooctanoate[5]	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorobutanoate	tissue	-	-	NA[4]	1.6	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoropentanoate	tissue	-	-	NA[4]	0.8	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorohexanoate	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoroheptanoate	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorononanoate	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorodecanoate	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoroundecanoate	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorododecanoate	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorotridecanoate	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorotetradecanoate	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorobutanesulfonate	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoropentanesulfonate	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorohexanesulfonate	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoroheptanesulfonate	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorononanesulfonate	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorodecanesulfonate	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorododecanesulfonate	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Fluorotelomer Sulfonate, 4:2-	tissue	-	-	NA[4]	1.6	ng/g dw	Axys	SGS Axys MLA-110 Rev 2

Matrix / Analyte Type	Analyte	CEDEN Matrix Code	Mon Trigger Level (MTL)	Target RL (1/2 MTL)	MDL	RL	Units	Lab	Method
Additional	Fluorotelomer Sulfonate, 6:2-	tissue	-	-	NA[4]	1.6	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Fluorotelomer Sulfonate, 8:2-	tissue	-	-	NA[4]	1.6	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Fluorotelomer Carboxylic Acid, 3:3-	tissue	-	-	NA[4]	1.6	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Fluorotelomer Carboxylic Acid, 5:3-	tissue	-	-	NA[4]	10	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Fluorotelomer Carboxylic Acid, 7:3-	tissue	-	-	NA[4]	10	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluorooctanesulfonamide	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Methyl-perfluorooctanesulfonamide, N-	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Ethyl-perfluorooctanesulfonamide, N-	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Methyl Perfluorooctane Sulfonamido Acetic Acid, N-	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Ethyl Perfluorooctane Sulfonamido Acetic Acid, N-	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Methyl-perfluorooctanesulfonamidoethanol, N-	tissue	-	-	NA[4]	4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Ethyl-perfluorooctanesulfonamidoethanol, N-	tissue	-	-	NA[4]	4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoro-2-Propoxypropanoic Acid	tissue	-	-	NA[4]	1.6	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoro-3,6-dioxaheptanoate	tissue	-	-	NA[4]	0.8	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoro-4-methoxybutanoate	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoro-3-methoxypropanoate	tissue	-	-	NA[4]	0.8	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Chloroeicosafluoro-3-Oxaundecane-1-Sulfonic Acid, 11-	tissue	-	-	NA[4]	1.6	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Chlorohexadecafluoro-3-Oxanonane-1-Sulfonic Acid, 9-	tissue	-	-	NA[4]	1.6	ng/g dw	Axys	SGS Axys MLA-110 Rev 2

Matrix / Analyte Type	Analyte	CEDEN Matrix Code	Mon Trigger Level (MTL)	Target RL (1/2 MTL)	MDL	RL	Units	Lab	Method
Additional	Dioxa-3H-Perfluorononanoate Acid, 4,8-	tissue	-	-	NA[4]	1.6	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Additional	Perfluoro(2-ethoxyethane)sulfonic acid	tissue	-	-	NA[4]	0.4	ng/g dw	Axys	SGS Axys MLA-110 Rev 2
Ancillary	Moisture	tissue	-	-	NA	NA	% ww	Axys	SGS Axys MLA-110 Rev 2
Ancillary	Lipid	tissue	-	-	NA	NA	% ww	Axys	SGS Axys MLA-110 Rev 2
Field Measurements[8]									
Required	Oxygen, Dissolved	sample water	-	-	-	-	mg/L	field crews	
Required	Oxygen, Dissolved	sample water	-	-	-	-	% saturation	field crews	
Required	pH	samplewater	-	-	-	-	pH	field crews	
Required	Specific Conductivity	samplewater	-	-	-	-	µS/cm	field crews	
Required	Temperature	samplewater	-	-	-	-	°C	field crews	
Required	Turbidity	samplewater	-	-	-	-	NTU or FNU	field crews	

[1] Triclocarban was removed from the analyte list for Year 1 because the planned methodology could not be implemented by the laboratory to meet project requirements. Triclocarban analysis has been reinstated for Year 2, though the analysis is still under method development by Physis; detection and reporting limits are not yet determined.

[2]SGS-Axys reports sample specific detection limits (SDLs),which are determined from the data of each individual analysis and vary between analytical batches; the estimated minimum detectable area is determined based on the signal to noise ratio for each individual result, per the method. SDL data will be reported in the MDL field in CEDEN per State Board guidance.

[3]While the state guidance only requires/recommends the analysis of 2 forms or congeners of PBDE, the SGS-Axys method includes an additional seven Congeners of Primary Interest, including, importantly PBDE-209.

[4]SGS-Axys reports sample specific detection limits (SDLs), which will vary between analytical batches: detection limit is the concentration equivalent of the lowest calibration level prorated to sample size. SDL data will be reported in the MDL field in CEDEN per State Board guidance.

[5]The state guidance requires/recommends monitoring of 2 perfluorinated compounds, PFOS and PFOA. The SGS-AXYS MLA-110 method for water and sediment includes 40 different compounds including both PFOS and PFOA along with 38 others.

[6]Whole clams will be shipped on ice to SGS-AXYS by MLJ. SGS-AXYS will do the shucking and compositing.

[7]Fish tissue will be prepared and composited by staff at the Moss Landing Marine Laboratory and shipped in sample bottles to Axys.

[8]Field crews shall measure standard field water quality parameters using a handheld meter and record readings on the field data sheet.

7.4.2. Laboratory QC Samples

Table 7-4 presents requirements for types and counts of ongoing laboratory QC samples. The definition of a laboratory batch will differ among laboratories and projects. However, for the purposes of this study, a laboratory batch is a group of samples prepared and analyzed at the same time that includes 20 or fewer field samples. This often represents a single sampling event for a given matrix and analyte group, but could represent more than one sampling event (e.g., if samples can be collected and held to analyze a larger group all at once), or could include more than one laboratory batch per collection event (e.g., if there are too many samples to process at once, or an issue such as instrument malfunction occurs before all sample analyses can be completed, needing samples to be analyzed at another time). Required laboratory QC frequencies are outlined in **Table 14-2**.

Table 7-4. Schedule of QA samples to be analyzed.

Matrix	Fraction	Analyzing Lab	Analyte Name	Sampling Events	Environ- mental Samples	Field Blanks	Field Duplicates	Total Field Samples	Lab Blanks	Lab Duplicates[1]	Laboratory Control samples[2]	Laboratory Control Duplicate	Matrix Spikes[3]	Matrix Spike Duplicates	Certified Reference Material	Total QA Samples
Water	Total	Weck	Estrone	4	48	4	4	56	4	0	4	4	0	0	0	12
Water	Total	Weck	Estradiol, 17beta-	4	48	4	4	56	4	0	4	4	0	0	0	12
Water	Total	Weck	Ibuprofen	4	48	4	4	56	4	0	4	4	0	0	0	12
Water	Total	Weck	Diclofenac	4	48	4	4	56	4	0	4	4	0	0	0	12
Water	Total	Weck	Triclosan	4	48	4	4	56	4	0	4	4	0	0	0	12
Water	Total	Weck	Bisphenol A	4	48	4	4	56	4	0	4	4	0	0	0	12
Water	Particulate	Weck	Suspended Sediment Concentration (SSC)	4	48	4	4	56	4	4	4	4	0	0	0	16
Water	Total	Physis	Galaxolide	4	48	4	4	56	4	0	4	0	4	4	0	16
Water	Total	Physis	Triclocarban	4	48	4	4	56	4	0	4	0	4	4	0	16
Water	Total	Vista	Perfluorooctanoate	4	48	4	4	56	4	0	4	4	0	0	0	12
Water	Total	Vista	Perfluorooctanesulfonate	4	48	4	4	56	4	0	4	4	0	0	0	12
Bed Sediment	Total	SGS-AXYS	PBDE 047	1	3	0	1	4	1	1	1	1	0	0	0	4
Bed Sediment	Total	SGS-AXYS	PBDE 099	1	3	0	1	4	1	1	1	1	0	0	0	4
Bed Sediment	Total	SGS-AXYS	Perfluorooctanesulfonate	1	3	0	1	4	1	1	1	1	0	0	0	4
Bed Sediment	Total	SGS-AXYS	Perfluorooctanoate	1	3	0	1	4	1	1	1	1	0	0	0	4
Bed Sediment	Total	SGS-AXYS	Moisture	1	3	0	1	4	n/a	1	n/a	n/a	n/a	n/a	n/a	1
Bed Sediment	Total	Weck	Total Organic Carbon	1	3	0	1	4	1	1	1	0	1	1	0	5
Bivalve Tissue	Total	SGS-AXYS	PBDE 047	1	6	0	0	6	1	1	1	1	0	0	0	4

Matrix	Fraction	Analyzing Lab	Analyte Name	Sampling Events	Environ- mental Samples	Field Blanks	Field Duplicates	Total Field Samples	Lab Blanks	Lab Duplicates[1]	Laboratory Control samples[2]	Laboratory Control Duplicate	Matrix Spikes[3]	Matrix Spike Duplicates	Certified Reference Material	Total QA Samples
Bivalve Tissue	Total	SGS-AXYS	PBDE 099	1	6	0	0	6	1	1	1	1	0	0	0	4
Bivalve Tissue	Total	SGS-AXYS	Moisture	1	6	0	0	6	n/a	1	n/a	n/a	n/a	n/a	n/a	1
Bivalve Tissue	Total	SGS-AXYS	Lipid	1	6	0	0	6	n/a	1	n/a	n/a	n/a	n/a	n/a	1
Fish Tissue	Total	SGS-AXYS	PBDE 047	1	4	0	0	4	1	1	1	1	0	0	0	4
Fish Tissue	Total	SGS-AXYS	PBDE 099	1	4	0	0	4	1	1	1	1	0	0	0	4
Fish Tissue	total	SGS-AXYS	Perfluorooctanesulfonate	1	4	0	0	4	1	1	1	1	0	0	0	4
Fish Tissue	total	SGS-AXYS	Perfluorooctanoate	1	4	0	0	4	1	1	1	1	0	0	0	4
Fish Tissue	total	SGS-AXYS	Moisture	1	4	0	0	4	n/a	1	n/a	n/a	n/a	n/a	n/a	0
Fish Tissue	total	SGS-AXYS	Lipid	1	4	0	0	4	n/a	1	n/a	n/a	n/a	n/a	n/a	0
			Total		**594**	**44**	**50**	**688**	**Total**	**20**	**55**		**13**	**13**	**0**	**198**

[1]Unspiked laboratory duplicates are not required for methods that require a whole bottle extraction.

[2]The term laboratory control sample is an umbrella term for QA/QC samples that laboratories might refer to by slightly different names. These include but are not limited to: Laboratory control spike, Matrix blank spike, Laboratory fortified blank. Key characteristics are that they are taken through the entire analytical process (unlike calibration verification samples), and made from a simple clean matrix (e.g. lab water, cleaned sand, pure oil).

[3]Spikes of natural environmental matrix samples should always be reported as "matrix spike" samples, and the results for the parent (pre-spike) sample reported as well. Matrix spike samples are not required where the method involves the environmental sample being spiked with labeled internal standards that contain a direct isotopic analog of the target analyte(s).

8. Special Training/Certifications

Laboratories must have a designated on-site QAO for the particular analytical component(s) performed at that laboratory. This individual will serve as the point of contact for the project QAO and DMT staff in identifying and resolving issues related to data quality.

To ensure that the samples are analyzed in a consistent manner throughout the duration of the program, key laboratory personnel participated in an orientation session conducted during an initial site visit or via communications with SFEI-ASC staff in year one. The purpose of the orientation session was to familiarize key laboratory personnel with this QAPP and the Delta RMP QA/QC program.

Personnel in any laboratory performing analyses will be well versed in good laboratory practices (GLPs), including standard safety procedures. It is the responsibility of the analytical laboratory manager and/or safety staff to ensure that all laboratory personnel are properly trained. Each laboratory is responsible for maintaining a current safety manual in compliance with Occupational Safety and Health Administration (OSHA) or equivalent state or local regulations. The safety manual will be readily available to laboratory personnel. Proper procedures for safe storage, handling, and disposal of chemicals will be followed at all times. Each chemical will be treated as a potential health hazard and GLPs will be implemented accordingly.

Contractors will train their personnel collecting samples in the field sampling methods described in the QAPP. Contractors shall maintain a record of field trainings given to their staff. Information recorded will include trainer(s), trainees, and dates of training. The sign-in sheet of the training can be the documentation of the training.

8.1. Training Certification and Documentation

Contractors performing sampling are responsible for providing training to their staff and maintaining records of all trainings. Those records shall be provided to the Project Manager if requested.

8.2. Training Personnel

Each contract laboratory's QAO and Safety Officer shall provide and/or designate staff to provide training to their respective personnel prior to performing work for the Delta RMP.

All personnel responsible for sampling will be trained in field sample collection and safety prior to the first day they are scheduled to sample for the Delta RMP.

9. Documentation and Records

All documents produced in the course of this study will be provided to the TAC for review. Data and publications shall be reviewed by the TAC and recommended by the Steering Committee to be approved by the Delta RMP BOD, and ultimately, provided to the CVRWQCB. The Delta RMP is in the process of updating its associated documentation to reflect the new governance structure.

Preliminary raw data and monitoring results shall be provided to the CVRWQCB within 60 calendar days from the date of sample analysis. Sampling and monitoring results shall be submitted to the CVRWQCB within 6 months from the date of sample analysis and the data must go through primary quality verification and corrective actions completed, if applicable.

MLJ will collect records for sample collection, field analyses, and laboratory chemical analyses. Samples sent to analytical laboratories will include a Chain-of-Custody (COC) form. The analytical laboratories will maintain records of sample receipt and storage, analyses, and reported results for a minimum of 5 years. Subcontractors shall send copies of the COC forms to MLJ immediately after the samples have been shipped to a laboratory, archives, or any other entity besides the field collection subcontractor.

MLJ will maintain hard-copy or scanned files of field notes and measurements as well as documentation and results submitted by laboratories at the MLJ office. The CEC Data Manager will be responsible for the storage and organization of information.

Contract laboratories will be responsible for maintaining copies of project documentation originating from their respective laboratories, with backup archival storage offsite where possible. All SOPs used for the Delta RMP will be stored indefinitely, in case future review is necessary.

9.1. Quality Assurance Documentation

All laboratories will have the latest revision of the Delta RMP CEC QAPP. In addition, the following documents and information will be current and available to all project personnel participating in the processing of project samples and to program officials:

1. CEC Sampling and Analysis Plan (CEC SAP): Containing instructions for fieldwork activities, including procedures for conducting field observations, field measurements, and environmental sample collection. Describe requirements for sample containers, volume, preservation, and storage.
2. Laboratory Quality Management Plan: Clearly defined policies and protocols specific to a particular laboratory, including policies and objectives, organizational authority, personnel responsibilities, and internal performance measures.

3. Laboratory Standard Operating Procedures (SOPs): Containing instructions for performing routine laboratory procedures (such as logging, labelling, and storage of samples; cleaning of equipment; checking of reagents) that could be but are not necessarily part of any analytical methodology for specific analytes or analyte types.
4. Laboratory Analytical Methods: Step-by-step instructions describing exactly how a method is implemented in the laboratory for a particular analytical procedure. Contains all analytical methods utilized in the particular laboratory for services provided to the Delta RMP.
5. Instrument Performance Information: Information on instrument baseline noise, calibration standard response, analytical precision and bias data, detection limits, etc. This information shall be reported for the periods during which Delta RMP samples are analyzed.
6. Control Charts: Control charts are useful in evaluating internal laboratory procedures and are helpful in identifying and correcting systematic error sources. Contract laboratories are encouraged to develop and maintain control charts whenever they will serve in determining sources of analytical problems.

Copies of laboratory methods, SOPs, and QA plans are available by request from the Project Manager. Some laboratory methods and SOPs may be edited for public review to exclude proprietary details about the analyses. All methods and SOPs will be provided in unredacted form to the QA Officer for the State Water Resources Control Board (State Board) for review and approval, but the State Board QA Officer will not share them with anyone else. The labs will provide information on methods and SOPs to TAC members and the CVRWQCB upon request and can provide full descriptions if TAC members sign nondisclosure agreements. Quality assurance documents are also reviewed to assure conformance to program needs by the QAO or their designees.

Handwritten original field sheets, logs, and calibration records will be maintained by the field sample collection teams, with copies maintained at MLJ.

Copies of all records will be maintained at MLJ and at the laboratory for a minimum of five years after project completion, after which they will be discarded, except for the database at MLJ, which will be maintained without discarding. All data will be backed up and secured at a remote location (i.e., separate from the MLJ office). As needed, data recovery can be initiated by contacting the back-up facility for restoration and this will be covered through MLJ overhead.

All individuals listed in **Section 3** will receive the most current version of this QAPP.

9.2. Standard Operating Procedures (SOPs)

The SOPs referenced in this QAPP are listed in **Table 9-1**. The Project QAO, CEC Project Manager, and the CVRWQCB QA Representative shall approve any changes in methods before implemented which will result in an update to the QAPP, to be reviewed and approved by all signatories.

Some laboratory SOPs are business confidential and will be made available to project staff. Stakeholders can request this information by contacting the project manager.

Table 9-1. Standard Operating Procedures (SOPs) referenced in this QAPP.

Originator	Title	Notes	Document Reference
Applied Marine Sciences (AMS)			
	Sampling and Analysis Plan for Delta CECs Pilot Study		Water Collection SAP
Marine Pollution Studies Laboratory (MPSL-DFW)			
	Tissue collection		MPSL-102a v 5, 2021
	Tissue preparation		MPSL-105 v 5, 2021
Weck Laboratories			
	Pharmaceuticals and personal care products	Weck asserts that its SOPs are proprietary and confidential	N/A
	TOC		N/A
	SSC		N/A
Vista Laboratory			
	PFAS	confidential information redacted	Vista-49
Physis Labs			
	EPA Method 625.1 (m)		Physis SOP for EPA Method 625.1 (m)
SGS-AXYS			
	BDE and BFR	Confidential, available for review upon request	MSU-033 R10
	PFAS in aqueous solids, tissues	Confidential, available for review upon request	MSU-110 R23
	Moisture Determination	Confidential, available for review upon request	SLA-015 R12
	Gravimetric Lipid Determination by Weight of Extract	Confidential, available for review upon request	SLA-020 R07
	Procedures for Homogenization of Solids and Tissues	Confidential, available for review upon request	SLA-013 R10

10. Sampling Process Design (Sampling Design and Logistics)

The section provides information about the field sampling, including details on the sampling locations, schedule, and the triggers for stormwater runoff or "wet-weather" sampling.

10.1. Sampling Locations

Planned sampling locations are listed below in **Table 10-1** and shown in the map in **Figure 4**. Samples will be collected from various locations including boats and shores (shores include piers, shoreline, and bridges). These locations were selected by the CEC Subcommittee as representative of major Delta inflows and urban runoff. Changes to the monitoring locations will constitute an update to the QAPP to be reviewed and approved by all relevant signatories, including the CVRWQCB QA Representative.

Field crews shall aim to collect all samples (except fish) in one day, or on two consecutive days, to minimize the hold times and to ensure that the tests can all be initiated in a single batch. The field crew will sample sites in the order that is most efficient in terms of time, fuel, and other logistical factors. This strategy may be altered for a storm event where the goal is to capture runoff that is a result of recent rains. Since the area covered by the sampling locations in Year 2 may not receive rain on the same day, the Sampling Lead and Project Manager will determine the best sampling strategy to obtain this objective depending on the storm magnitude and confidence in timing balanced with logistical factors. Rationale for not sampling all sites in a day or on two consecutive days due to storm logistics will be documented.

Prior to any sample collection (except fish), each site shall be visited by crew leads to assess sampling safety, feasibility, and constraints. The following site parameters shall be assessed and recorded on a field sheet or form:

- Site Name
- Date/Time
- Field personnel
- Site Coordinates and datum (WGS 84 to 5 decimal places, e.g. -XXX.XXXXX)
- Physical description of site
- Graffiti absence/presence
- Unsheltered persons encampments absence/presence
- Exit strategy if team member fell in water body

- Overall safety assessment with description if poor: Good to poor
- Physical description of sampling location e.g. downstream side bridge sidewalk, marina pier number, bank location (you want to be as descriptive as possible so field teams can re-occupy a sampling location)
- Parking location
- Access or "Occupation" Method: walk in, from bridge
- Recommended sampling equipment (include if a pole or rope needed and length needed)
- Identify nearby lighting if any sampling will occur in the dark

In addition to pre-sampling field reconnaissance, a field safety review shall occur each time a field crew gets to a sampling site in order to assess any safety hazards. Once the sampling team is on site, the following shall occur:

- Identify the sampling site and location code and ensure that the correct site/sample ID is on field sheets and sample bottles.
- Discuss the sampling methods for the site.
- Identify any potential hazards; e.g. ledges, steep slopes, slippery riprap or mud or grasses, traffic, tripping hazards, water levels (if wade in sample is required).
- Have a plan for what happens if someone falls into the waterbody.
- Set up any safety equipment (cones, PFD, ropes).
- Locate the site packet with hospital information.
- Identify where the vehicle keys are located.

Table 10-1. Planned sampling locations for Year 2.

Num	CEDEN Station Code	Station Name	Latitude	Longitude	Number of sampling events per year, for each target matrix:				Take Water Sample from	Agency doing sampling for each matrix:				Notes
					Water	Sediment	Fish	Bivalves		Water	Sediment	Fish	Bivalves	
1	519SUT108[1]	Sacramento River at Elkhorn Boat Launch Facility	38.67245	-121.625	4	-	1	1	Boat Launch Dock	AMS	-	MPSL-DFW	AMS	Sample from the pier at the Elkhorn Boat Launch Facility, 5827 Garden Hwy, Sacramento, CA 95837.
2	510ST1301[2]	Sacramento River at Freeport	38.45555	-121.50194	4	-	1	1	Midchannel	AMS	-	MPSL-DFW	AMS	
3	510SACC3A	Sacramento River at Hood Monitoring Station Platform	38.36771	-121.5205	4	-	-	1	Midchannel	AMS	-		AMS	Sample midchannel via boat.
4	519AMNDVY	American River at Discovery Park	38.60094	-121.5055	4	1	-	1	Midchannel	AMS	UCD-GC (SPoT)		AMS	
5	541SJC501	San Joaquin River at Airport Way near Vernalis	37.67556	-121.26417	4	-	1	1	Bank	AMS	-	MPSL-DFW	AMS	Year 1 DWR sampled from the platform at River Club; Year 2 may be at bridge.
6	544LSAC13	San Joaquin River at Buckley Cove	37.971833	-121.373619	4	-	1	1	Bank	AMS	-	MPSL-DFW	AMS	Year 1 sampled from bank

Num	CEDEN Station Code	Station Name	Latitude	Longitude	Number of sampling events per year, for each target matrix:				Take Water Sample from	Agency doing sampling for each matrix:				Notes
					Water	Sediment	Fish	Bivalves		Water	Sediment	Fish	Bivalves	
														access via boat or shore.
7	519DRYCRK	Dry Creek at Roseville WWTP	38.734098	-121.31444	4	1	-	-	Midchannel	AMS	AMS	-	-	Walk-in site sampled midchannel. Use pole sampler. Access from Roseville WWTP.
8	511SOL011	Old Alamo Creek at Lewis Road	38.34643	-121.89684	4	1	-	-	Bridge	AMS	AMS	-	-	Walk-in site sampled midchannel. Use pole sampler.
9	TBD	POTW Source No. 1	38.733899	-121.315051	4	-	-	-	Bank	AMS	-	-	-	
10	TBD	POTW Source No. 2	38.346617	-121.901601	4	-	-	-	Bank	AMS	-	-	-	
11	TBD	Sacramento Urban Runoff	38.601271	-121.492956	4	-	-	-	Bank	AMS	-	-	-	
12	TBD	Roseville Urban Runoff	38.80477	-121.32733	4	-	-	-	Bank	AMS	-	-	-	
		Roseville Urban Runoff (option 2)	38.802707	-121.338524										Three Roseville locations are identified in the Pilot Study Workplan as
		Roseville Urban Runoff (option 3)	38.802599	-121.338787										

Num	CEDEN Station Code	Station Name	Latitude	Longitude	Number of sampling events per year, for each target matrix:				Take Water Sample from	Agency doing sampling for each matrix:				Notes
					Water	Sediment	Fish	Bivalves		Water	Sediment	Fish	Bivalves	
														potential locations.
		Number of distinct sampling locations:			12	3	4	6						
		Total samples planned in Year 1:			32	3	4	6						
		Total samples planned in Year 2:			48	3	4	6						

[1] Fish are reported as 519ST1309, Sacramento River at Veterans Bridge-03SWSBIO-519ST1309

[2] Fish are reported as 510ST1317, Sacramento River/Freeport-510ST1317

Health and safety during the COVID-19 pandemic

Field sampling procedures have been updated to address concerns associated with the COVID-19 pandemic. For MPSL-DFW, they require San Jose State University protocols. For AMS and associated contractors, procedures include having field crews drive in separate vehicles. Field safety protocols may change as information regarding the pandemic is updated. Any changes to the protocols will be discussed with the Project Manager and QAO to ensure field crew safety. AMS sampling personnel will be provided with a Job Hazards Analysis (JHA) outlining all identified risk factors, including COVID-19, prior to conduct of any field activities.

If a sampling site cannot be accessed

Safety comes first. If a planned sampling site is unsafe, field crews shall turn back immediately and get to safety. For instances where a site is inaccessible due to a fence, locked gate, etc., field crews shall seek out a solution, and contact the project manager for assistance. Any changes to sampling sites require approval by the CVRWQCB QA Representative or the SWB QA Officer prior to sampling, except where described below.

Water and sediment sampling - If the field crew determines that a sampling site is inaccessible or unsafe, a sample shall be taken within 100 meters if possible and only if there is not some obvious change in the environment, such as moving downstream of an outfall, a change in water clarity, etc. If not possible to sample within 100 m, field crews shall contact the project manager for assistance and approval is required by the CVRWQCB QA Representative or the SWB QA Officer prior to sample collection.

Fish and clam sampling - If organisms cannot be found at a planned site, field crews shall use their best judgment and seek to sample at another nearby location. The sample shall be taken from the same water body as planned, i.e. not in a tributary or side channel. The alternative sampling site shall be within 1 km and sampled only if there is not some obvious change in the environment, such as moving downstream of an outfall. If not possible to sample within 1 km of the planned location, field crews shall contact the project manager for assistance and approval is required by the CVRWQCB QA Representative or the SWB QA Officer prior to sample collection.

Field crews shall take careful note of the sampling location using the field data sheet as described in **Section 6.1**. The latitude/longitude coordinates of the actual location shall be logged using a GPS.

All of the information collected by field crews is considered critical, and not merely for informational purposes. If a site is totally inaccessible and a nearby alternative is not practical, project scientists shall consider sampling at another nearby or similar site, or on a different day

and shall seek approval from the CVRWQCB QA Representative or the SWB QA Officer prior to sample collection. Such decisions shall be carefully noted using a QAPP Deviation Form and will need to describe the corrective response action taken. If practical, input for such decisions shall be gathered from the Delta RMP Technical Advisory Committee.

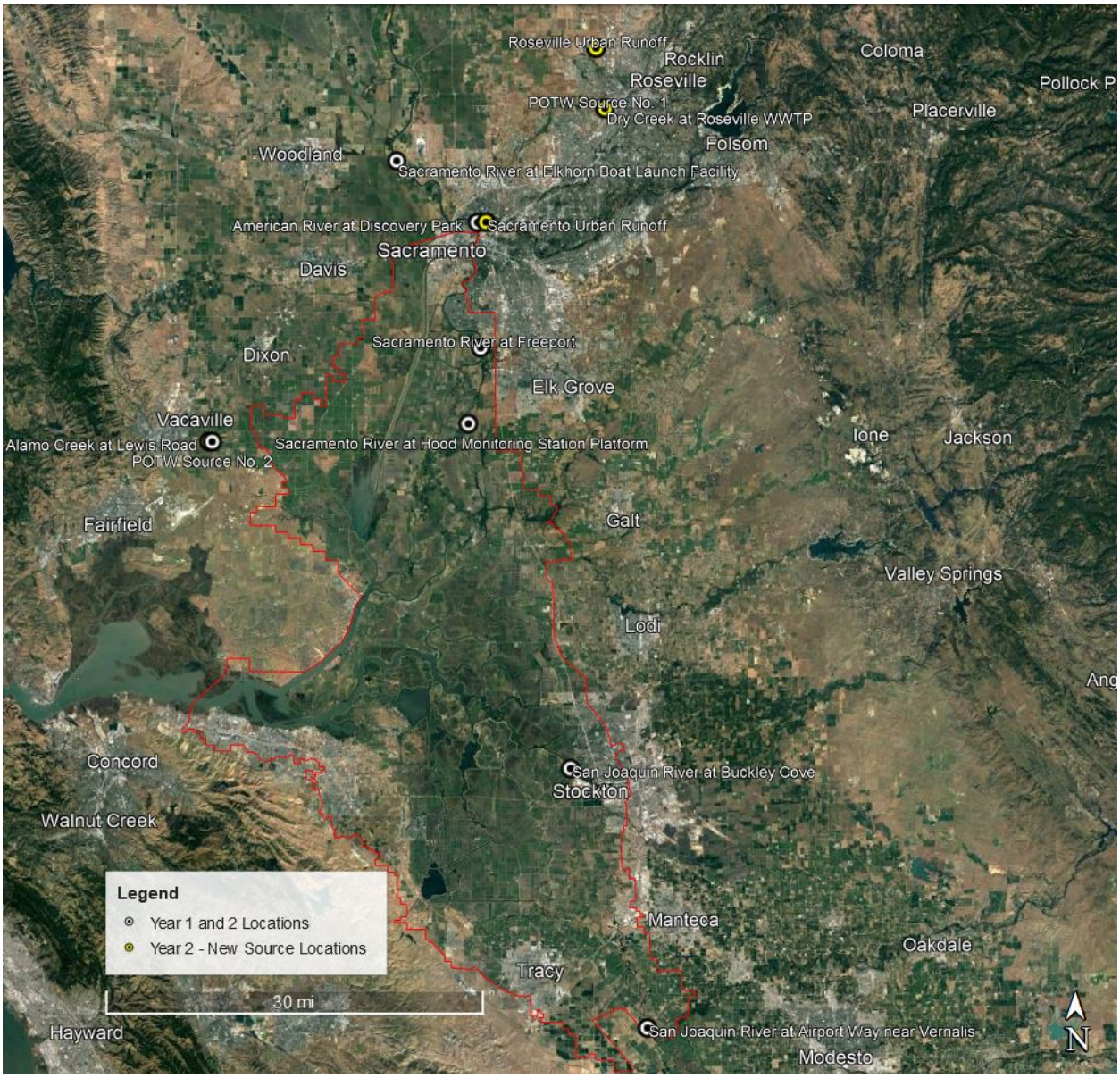


Figure 4. Map of sampling locations.

Labels show the CEDEN station code, station name, and type of samples to be collected. See also **Table 10-1**.

10.2. Sampling Schedule

Fish will be sampled once per year. Sampling will be performed summer to late fall, to coincide with Delta RMP sport fish sampling for mercury whenever possible. Fish are commonly

sampled in summer and late fall (after a season of mercury accumulation and before wet season storms) so these data will be consistent with long-term datasets for other constituents.

Clam and sediment sampling will also be done once per year. These samples will be collected during the late summer, early fall season (August - October). This is consistent with the timing of sampling that occurred in Year 1 (September) and timing expected in Year 2 (October). SPoT sampling may occur earlier than other sediment collection based on their collection schedule (July). We expect that the largest percentage of wastewater in river flows occurs during the summer and constituents accumulate to their "maximum" concentrations in clam tissue, although we do not have data or studies to confirm this hypothesis. See **Table 10-2** for the schedule and timing of water sampling events. The sampling schedule may need to be adjusted or delayed due to the coronavirus pandemic and related restrictions that are affecting work schedules but will try to be consistent from year to year to reflect the intent of the study design. Year 1 sampling was not able to begin until September.

Table 10-2. Schedule and timing of sampling events.

Event Number	Description	Timing	Storm trigger for wet-weather events
1	Late summer, early Fall	August, September, or October	n/a
2	First flush (Wet 1)	October - January	Yes--see **Table 10-3**
3	Spring storm (Wet 2)	Feb, Mar, or April of	Yes--see **Table 10-3**
4	Summer - dry season	May, June, or July	n/a

For water, field crews will conduct 4 sampling events (2 dry-weather, and 2 wet-weather), spaced about equally throughout the year; ideally, sampling events shall occur more than one month apart, but exceptions will occur if the boat is unavailable. The timing of water sampling events will be scheduled in collaboration with the staff of AMS, so that water samples will be collected on the same day, or up to 2 adjacent days and can be analyzed by the laboratory as a single batch if all can be analyzed within hold time. The exact timing will depend to some extent on the availability of crews and boats. Any sampling outside of the timing listed in **Table 10-2** will require approval by the CVRWQCB QA Representative or the SWB QA Officer prior to sample collection.

Sources of natural variability include seasonal flow and biological activity, which will be addressed by a consistent seasonal sampling schedule. This variability will be reconciled with project information by observing site conditions, assessing ancillary measurements, and evaluating spatial and temporal trends.

Potential sources of bias or misrepresentation can arise from sampling minor inputs or disturbances rather than bulk ambient water. Their contribution will be minimized by sampling at locations identified as representative of ambient inflows and following sampling procedures described in **Section 11**.

10.3. Wet-Weather Triggers

Two storms shall be sampled, and preferably those two storms shall have different characteristics. This study's objective of wet-weather sampling is to characterize the influence of urban runoff. The strategy is to best capture the rising limb, or near the peak of the hydrograph, in safe conditions, while allowing reasonable mobilization times. In general, stormwater season in Northern California is between October 1 - April 30. This project intends to sample two wet-weather events:

1. First flush (likely Oct - Jan)
2. Spring storm (Feb, Mar, or April)

Table 10-3 shows the "triggers" for stormwater sampling. These triggers apply for all water monitoring locations, including the large riverine sites and smaller tributaries. The triggers for this project were based on the triggers used in the past by the Sacramento Stormwater Quality Partnership (Brian Laurenson, Larry Walker Associates, personal communication). It is expected that not all locations may meet the precipitation and probability triggers outlined in Table 10-3 and therefore it is left to the discretion of the CVRWQCB QA Representative, Project Manager and Sampling Lead to determine the best timing for sampling based on storm tracking records and best judgements and changes will be approved by the CVRWQCB QA Representative or the SWB QA Officer. The Sampling Lead will retain records of storm tracking information to retain documentation for decisions associated with sampling or not sampling a predicted storm. It is up to the discretion of the CVRWQCB QA Representative, Project Manager and Sampling Lead to call off a sampling event no later than 24 hours before crews will go into the field based on precipitation predictions and the best use of resources.

Table 10-3. Stormwater sampling triggers.

Event	Forecast Precipitation in 24 hours over basin* (inches)	Minimum Probability 48 hours prior to event	Notes
First flush	0.5	50%	In some years, larger rainfalls have not occurred until November or even December. Lower probability is deemed acceptable as we wish to aggressively target the first flush event of the season. If there is not accumulation of 0.5" as forecast, it is likely that lower precipitation amounts of 0.25" or less will have caused urban runoff.
Spring storm	0.25	75%	Planned for February, March, or April

*Basin precipitation to be estimated based on NWS forecasts for Sacramento and Stockton

Project staff will make the decision on when to sample stormwater. Both the Project Manager and Sampling Lead have extensive experience in stormwater sampling in the region and will lead the decision-making process with prior approval from the CVRWQCB QA Representative. The Project Manager will report via email to the TAC on the decisions that were made and the rationale. Project staff shall assess rainfall forecasts using two National Weather Service (NWS) locations:

- Sacramento (Sacramento Executive Airport)
- Stockton (Stockton Metropolitan Airport)

It is desirable to capture the "rising limb" of the hydrograph, the period during which discharge is increasing as a result of rainfall-induced runoff. In making the "go/no go" decision for whether to monitor a storm, project staff will also consult guidance plots at appropriate discharge sites or recorded discharge at upstream flow stations (in making the decision to mobilize, the recorded discharge at upstream flow stations shall show an approximately 2-3X increase in flows). The timing of actual sampling shall take streamflow peak travel time into consideration. Guidance plots developed by the California Department of Water Resources (https://cdec.water.ca.gov/guidance_plots/) show forecast river flow and stage, and are available for dozens of river reaches in the Central Valley.

Samples will be collected during the day; if sampling crews determine that the samples scheduled for the daylight hours cannot be collected, they will discuss options with the Sampling Lead and Project Manager to determine next actions and will obtain prior approval

from the CVRWQCB QA Representative or the SWB QA Officer. Sampling days will be scheduled with the intent to collect all scheduled samples during daylight hours. By preference, sampling shall occur no more than 12 hours after the last hour with rainfall totals of less than 0.1 inch over the target area.

To the greatest extent possible, samples will be collected in such a manner that the impact of urban runoff on ambient water quality can be assessed. While this approach is preferred, safety concerns and constraints on the timing of sample collection will make this approach impractical and another strategy will need to be developed for a given event. Any modifications to the preferred approach shall be documented in the field notes and a deviation form. The CVRWQCB QA Representative, PM, and QAO decide whether the project workplan and QAPP require modification; proposed modifications are brought to the TAC and SC for review and approval and approval is required from the CVRWQCB QA Representative.

11. Sampling (Sample Collection) Methods

The following sections describe sampling methods for each analyte. With emerging constituents and organic compounds, samples require special handling to avoid contamination and other interferences. Guidance on appropriate sample handling was based on the project team's professional experience, discussions and correspondence with laboratory staff and other scientists, and from reviewing the literature on similar studies.

The sampling list included for CEC analysis incorporates monitoring for a variety of analytes with historic uses as hormones, plasticizers, pharmaceuticals, and personal care products (PPCPs), flame retardants, and non-stick coatings. Sampling protocols for this effort have been designed to minimize influence of sampling operations upon monitoring results, with precautions incorporated to address influence associated with analytes most likely to be contaminated through typical monitoring operations:

- Bisphenol-A - used primarily in the production of polycarbonate plastics and epoxy resins.
- PFAS - used in a variety of industrial, commercial, and consumer products, including materials used for environmental monitoring. Some of these products could be present and/or used during a routine sampling event, such as plastic bags and bottles, waterproof clothing, detergents, and waterproof pens and paper.

The CEC field sampling procedures have preventative measures to reduce the potential contamination risks. These actions include having designated areas for eating, staging and sampling.

Consistent with State Water Board PFAS sampling guidance documents (2020), sampling materials and field supplies are divided into three groups that indicate their potential usage associated with monitoring:

- Allowable materials: These materials are unlikely to be sources of cross contamination and can be used during all sampling stages in the immediate sampling environment.
- Staging area-only materials: These materials may contain potential sources of contamination and should not come into direct contact with the sample but can be used in the staging area away from sample bottles and equipment. Care should be taken to thoroughly wash / sanitize hands and don new gloves after handling any of these materials.
- Prohibited materials: These include items that are well-documented to contain contaminating materials and may present a threat to the integrity of the sample.

Additional details associated with each of these materials can be found in **Appendix C**.

When problems occur the field crew shall use their judgment for small problems, or for larger issues, contact the project manager to decide on the best course of action. Deviations from the project plan described in this QAPP shall be documented by project personnel using the QAPP Deviation Form and shall be approved by the CVRWQCB QA Representative or SWB QA Officer prior to occurrence. When prior approval is not possible, the deviations must be reported to the Central Valley Water Board Quality Assurance Representative within 7 calendar days. If the deviation requires a QAPP update, the update will be completed prior to the next sampling event, approved by the CVRWQCB QA Representative, and submitted for review and signatures. Any project participant (including staff, contractors, collaborators, and members of the SC, TAC, and subcommittees) may recommend the use of the form, but the Project Manager and QA Officer are responsible for initiating the form and documenting any corrective action that will be planned and informing and seeking approval from the CVRWQCB QA Representative or SWB QA Officer.

Some partner agencies performing sample collection as part of this project will utilize field methods described in an SOP or QAPP for a related project. For example, field crews from the Stream Pollution Trends Monitoring Program (SPoT) have agreed to collect a sediment sample from a deep-water location in the American River; their quality assurance procedures are detailed in the SPoT QAPP, December 2018. For all other field crews, this document describes the sample collection methods and QA procedures to utilize for this project.

Sample containers and any preservative for laboratory sample processing will be provided by each laboratory performing the respective analysis. The container types to use for each analyte are listed in **Table 12-1**.

11.1. Sediment sample collection for PBDE and PFOS/PFOA analyses

Sediment will be collected at 3 sampling locations (**Table 10-1**) during 1 event per year. Sediment samples will be analyzed for polybrominated diphenyl ethers (PBDE 047 and PBDE 099) and perfluorinated compounds (PFOA and PFOS). Field crews from SPoT will collect sediment from one location. The crew will follow the procedures specific to this study described below for any samples collected for this DRMP project. AMS staff will collect sediment from the other two locations, in conjunction with the water sampling. Sampling procedures will be the same between SPoT staff and AMS staff, with any deviations noted.

This methodology for sediment sampling has been adapted from the Bay RMP sampling methodology for CECs. Sampling equipment will be dependent on the size and depth of the creek. In order to increase the representativeness of the sample, it is recommended that each sediment sample be a composite of 2-3 grabs from adjacent places on the river bed (note that this isn't possible for the PFOA/PFOS samples as described below, as they are scooped directly into the sample container and are not composited). Avoid contact with all teflon products and computer components when collecting and processing samples. Clean nitrile gloves shall be used at each new sampling site. The methodology for collecting and processing sediment samples is described below.

Prior to sampling all equipment will be thoroughly cleaned. Equipment that is pre-cleaned includes:

- the modified 0.1 m^2 stainless steel Van Veen Sediment grab (for vessel-based sampling only)
- a stainless steel scoop or spoon,
- a stainless steel bucket

(Note that the Van Veen grab will be used at the deep water site, American River at Discovery Park, while the stainless steel scoop only will be used at the other 2 sites).

The procedures for cleaning sampling equipment is as follows:

- Soak equipment (fully immersed) for three days in a 0.5 % solution of lab-grade detergent such as Liquinox™ detergent and deionized water.
- Rinse equipment three times with deionized water and let dry in a clean place.
- Rinse equipment with 1.0% solution of hydrochloric acid, followed by a rinse with methanol, followed by another set of three rinses with deionized water. All equipment is then allowed to dry in a clean place.

- The cleaned grab and stainless steel scoops are wrapped in aluminum foil (dull side touching the equipment) until used in the field. All other equipment is stored in clean Ziploc™ bags (polyethylene) until used in the field.

Where possible, 2-3 grab samples from the Van Veen or stainless steel scoop will be collected. The top 0-5 cm of sediment of each grab shall be used for samples and compositing.

Sampling Sediment for PFOS and PFOA Analysis

For the first grab, sediment will be scooped directly from the grab sampler or scoop, into the sample jars provided by the laboratory for PFOA/PFOS analysis. Try to get the full 0–5 cm layer of sediment into each sample jar. Take the sample from the center of the sampler, and avoid touching the edges of the equipment with the sample jar. Ensure that no teflon products come in contact with the sediment or sampling equipment before taking the sample for PFOA/PFOS. If more mass is needed, repeat the above for subsequent grabs.

Sampling Sediment for PBDE Analysis

The samples for PBDE analysis will be mixed and composited. The remainder of the top 0–5 cm of the first grab (for vessel-based sampling) will be scooped into the pre-cleaned stainless steel bucket. Take an additional 2 to 3 grabs adding the top 0–5 cm of subsequent grabs to the bucket.

Once all sediment is collected, the compositing bucket and scoops are transferred into the vessel cabin (if sampling from boat) and the doors closed for processing; this is done so that the vessel will get underway while minimizing potential effect of vessel exhaust on sample material. Sample material is then mixed using stainless steel scoops / spoons to achieve a consistent appearance, which will be difficult with particular substrate types (i.e., heavily consolidated materials). While mixing, sampling personnel shall take care to avoid scraping the coated bucket. Particular attention shall be paid to the edges of scoops and spoons – when bare metal shows, they shall be replaced with backups.

Composited material is then sub sampled into sampling containers provided by the laboratory for PBDE and Total Organic Carbon.

Sediment Storage and Transportation

All samples will be put in a cooler on wet ice immediately. If samples are not shipped immediately, they shall be placed in a sample freezer until shipment to laboratories.

Quality Criteria / When to Reject Sediment Samples

The quality of grab samples will be ensured by requiring each sample to satisfy a set of criteria concerning the depth of penetration and disturbance of the sediment within the grab. In this way, each sample will normally contain the top 5 cm of sediment within the area of the grab jaws. Grab samples will be rejected for the following conditions:

- There is a rock or shell fragment wedged between the jaws of the grab allowing the sample to wash out.
- The sample surface is significantly disturbed.
- The sample is uneven from side to side, indicating that the grab was tilted when it penetrated the sediment.
- The surface of the sample is in contact with the top doors of the grab, indicating over-penetration of the grab and possible loss of material around the doors.

The total number of grabs or cores taken will be recorded by field personnel on the field datasheets.

Cleaning Sediment Sampling Equipment

If sampling equipment is to be reused in a given day, it will be rinsed with ambient water (prior to arrival, to avoid contaminating the next site), followed by a plastic brush scrub with lab-grade detergent (if microplastics and surfactants are not being considered for analysis in current or archived samples), and rinsed with DI water, and methanol, then rinsed again with DI water and allowed to drip dry to the extent possible. DI rinse water and methanol will be dispensed from a labeled 500 mL wide mouth rinse bottle made of LDPE with a polypropylene lid.

If, during future sampling events, analysis of metals is planned, add a rinse with dilute acid followed by DI water.

11.2. Water sample collection for PBDE, Emerging Constituents, and PFOS/PFOA analyses

Water samples will be collected at 12 sampling locations (**Table 10-1**) during 4 events per year: 2 dry weather events and 2 stormwater events per year. Water samples will be analyzed for estrone, 17-beta-estradiol, ibuprofen, diclofenac, galaxolide (HHCB), triclosan, triclocarban, bisphenol A, PFOA, and PFOS.

For sample bottles without pre-added preservative, samples should be collected directly into the sample bottle. For bottles with preservative, a pre-cleaned bottle (of the same material as the sample bottle) without preservative will be used to sample the water, which will then be poured into the pre-cleaned bottles containing preservatives provided by the laboratory. The unopened sample bottles provided by the laboratory will first be dunked in site water to rinse off external contamination. The sample will be collected away from the water in which the bottle was rinsed (e.g., on the opposite side of the boat, or after currents carry away possible contamination). As required, a stainless-steel sampling pole may be used with the sample collection bottle fitted at the end of the pole.

Samples shall be collected, when possible, mid-stream. Samples shall be collected 0.5 m below the surface, or closer to the surface at mid-depth in shallow tributaries if the water depth is less than 0.5 m. For wade-in locations, the crew member will collect sample water upstream of where they are standing.

Clean nitrile gloves shall be used while handling sample bottles. Samples will be stored on ice until transfer into a refrigerator and shipment to the analytical laboratories.

Field blanks and field duplicates shall be collected according to the schedule in **Table 14-2**. Methods for collecting blank samples are described in **Section 7.3.2 Field Sample Collection**.

11.3. Fish sample collection for PBDE and PFOS/PFOA analyses

Fish samples for analysis of PBDE and PFOS/PFOA will be collected annually at 4 locations and will coincide with the existing sampling effort for analyses of mercury and methyl mercury (typically in the fall of each year) whenever possible. The appropriate sample collection method will vary by site and will be determined by the MPSL-DFW field sample collection team. Fish will be collected as individuals and then processed into composite samples (up to 5 fish per composite).

References and links for accessing SOPs for fish sample collection are provided in **Table 9-1**.

Fish will be collected in accordance with MPSL-102a v 5, 2021 Sampling Marine and Freshwater Fish and Invertebrates for Trace Metal and Synthetic Organic Analysis (MPSL-102a); **Section 7.4**. Because habitats will vary greatly, there is no one method of collection that is appropriate. Field crews will evaluate each fishing site to determine the correct method to be employed. Potential sampling methods include but are not limited to: electroshocking, seining, gill netting, and hook and line. Field crew will determine the appropriate collection method based on physical site parameters such as depth, width, flow, and accessibility. Field crew will indicate the collection method on data sheets.

Fish will be field processed according to MPSL-102a; except where noted here. Collected fish may be partially dissected in the field. At the dock, the fish is placed on a measuring board covered with clean aluminum foil or plastic. Fork and total length are recorded. Weight is recorded, if the fish is large enough for the scale. If the fish is too large to fit in the bag, it will be placed on the covered cutting board, where the head, tail, and guts are removed using a clean cleaver (scrubbed with Micro™, rinsed with tap and deionized water). The fish cross-section is tagged with a unique numbered ID, wrapped in aluminum foil, and placed in a clean labeled bag. When possible, parasites and body anomalies are noted. The cleaver and cutting board are re-cleaned with Micro™, rinsed with tap and deionized water between fish species. The equipment cleaning procedures will be repeated at each sampling site.

11.4. Clam tissue sample collection for PBDE

Resident *Corbicula fluminea* will be collected at 6 locations once per year, for up to 3 years. Samples will be collected using a clam dredge towed behind a research boat. The dredge, shown below in **Figure 6** is made of stainless steel with a sacrificial metal rake head secured at its mouth. The dredge has skids on the bottom to allow it to skim across the seafloor while the front-mounted rake digs into the sediment. A rigid stainless mesh cage collects bivalves after they are liberated from the sediment. During Year 1, clam collection by boat could not occur at the San Joaquin River at Vernalis location due to shallow waters. If clams cannot be collected by boat, AMS will attempt a hand collection method and the CVRWQCB QA Representative will be notified.

A crew of at least three people is required. The skipper is responsible for boat operations and two deckhands are responsible for dredge deployment and recovery, and sample processing.

Before deployment, a small plastic float and line are attached to the tail end of the dredge to assist with recovery if it becomes stuck. Additional plastic floats will be secured to the dredge to keep it upright in the water column during descent to the bottom.

While the boat is moving, the deckhands will deploy the dredge using a powered winch or by hand. The skipper will proceed at low speed against the current with the dredge dragging along the seafloor. The boat continues dredging operations until it leaves the target sampling area, encounters an obstruction or resistance, or has been collecting for a sufficient period of time to provide enough sample material to process. At this point, the skipper takes the boat out of gear and the deckhands begin dredge retrieval.

Upon retrieval, if the cage is filled with sediment, deckhands will rinse the cage to remove some of the mud. If no clams are collected, deckhands will empty the dredge and immediately re-deploy. If clams are present in the cage, a deckhand will dump the clams into a pre-cleaned non-coated metal bucket. Note that due to the nature of chemical analysis to be performed on these samples, clams should not be in contact with plastic or Teflon surfaces during processing.

Deckhands, wearing new nitrile laboratory gloves, will then sort through the dredged material to remove extraneous material and dead clams. Live clams are rinsed with deck water to remove adhered sediments and placed into a second pre-cleaned non-coated metal bucket for temporary storage.

The above process is repeated until a sufficient number and mass of clams is collected to support all analyses. At this point, deckhands will sort and measure all clams to select a representative number / volume of clams for analysis, wrap each in clean aluminum foil, and transfer to a zip-top bag. The zip-top bags are sealed and labeled with project name, site name, sample ID, sample date, and analysis. Bags are immediately transferred to a pre-cleaned cooler

filled with dry ice for freezing. Coolers will be cleaned with a laboratory detergent before each sampling effort. Unless otherwise noted, samples are kept frozen through delivery to the lab(s).

As the field crews are not opening the clams, rigorous cleaning of sampling equipment is not necessary. After each use of the dredge, empty the dredge of clams then rinse with site water.

A composite of a minimum of 20 *Corbicula fluminea* clams will be collected using roughly the same proportion of clams that is representative of the size classes observed at the sample location. The size distribution of clams in the subsample should be roughly proportional to size distribution of clams in the larger sample, such that the proportion of mass provided by different sized clams in the subsample matches that of the larger sample.

The minimum mass required to support all analyses is 12 g of wet tissue mass per composite (18 g for replicate sites). In order to generate the minimum desired mass, field staff will estimate wet tissue mass before generating the field composite and before discarding any clams from a site. Based upon results of 2020 monitoring, field staff should estimate tissue mass using the following estimates of mass for a given size range shown in **Table 11-1**.

Table 11-1. Estimated Clam Mass by Size Range

Size Range	Estimated Mass (g)
10 – 15 mm	0.1
15 – 20 mm	0.4
20 – 25 mm	1.5
25 – 30 mm	1.8
>30 mm	2

For sites where the estimated mass falls near or below the minimum requirements, field staff should use best professional judgment to increase the number of clams in the aliquot to a sufficient mass to satisfy laboratory requirements. This may include over-representing clams from larger bin sizes, including a much larger number of clams from the smaller bin sizes, or some combination. Decision making should be documented in field datasheets.

Field crews will measure the length, width, and weight of each clam in the subsample to provide an estimate of the sampled clam biomass (and possibly age). Clam weights are typically reported as ash-free-dry-weights (AFDW), which is not a practical measurement for this study.

Field crews will measure along the length of the clam shells (see below). This is also the measurement method used by USGS and DWR in the Delta (Tim Mussen, personal communication, Feb. 3, 2020).

How to measure clam shell width and length are shown in **Figure 5**.

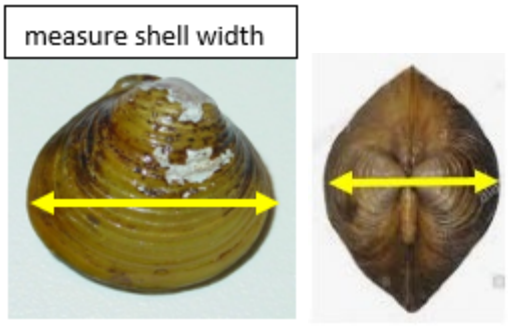


Figure 5.Clam shell length (left) and width (right)

Once the clams are received by the laboratory, clam shells will be rinsed with HPLC grade reagent water in order to wash exterior sediment off of the shells and prevent soil from getting inside the bivalve during shucking. Clam tissue will be thawed, shucked, and homogenized in an Omni Mixer blender and immediately returned to cold storage. Homogenized clam tissue will then be spiked with ^{13}C-labelled surrogate standards prior to analysis. Samples will be extracted and analyzed by high-resolution gas chromatography with high-resolution mass spectrometric detection (HRGC-HRMS; described in SGS-AXYS SOP MSU-033 R08; MLA-033-R06.08).

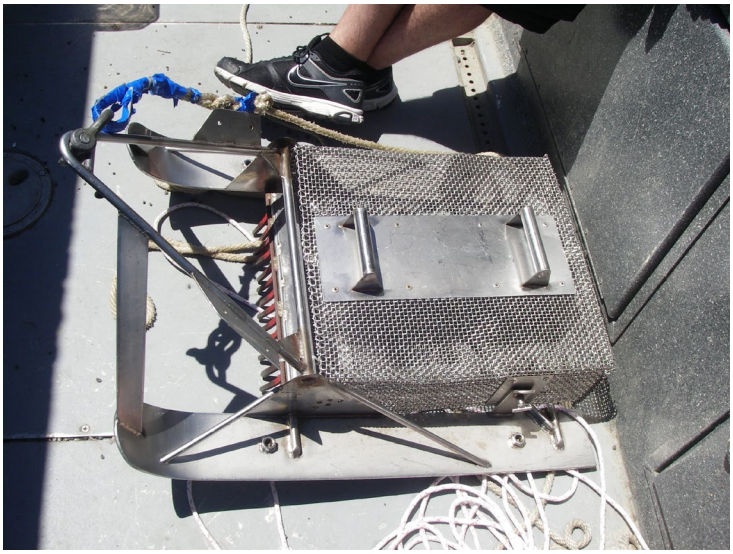


Figure 6. Clam dredge to be used by AMS field crews for collecting clams.

Table 11-2. Collection devices and methods for collection of water, sediment, and tissue samples.

Name	Matrix	Notes	Collection Device	Collection Method	Source
Estrone	Freshwater		Individual Bottle by pole sampler	Grab sample - stainless steel sampling pole with sample collection bottle	Maruya et al. (2018)
17-beta-estradiol	Freshwater		Individual Bottle by pole sampler	Grab sample - stainless steel sampling pole with sample collection bottle	Maruya et al. (2018)
Ibuprofen	Freshwater		Individual Bottle by pole sampler	Grab sample - stainless steel sampling pole with sample collection bottle	Maruya et al. (2018)
Diclofenac	Freshwater		Individual Bottle by pole sampler	Grab sample - stainless steel sampling pole with sample collection bottle	Maruya et al. (2018)
Galaxolide (HHCB)	Freshwater		Individual Bottle by pole sampler	Grab sample - stainless steel sampling pole with sample collection bottle	Maruya et al. (2018)
Triclosan	Freshwater		Individual Bottle by pole sampler	Grab sample - stainless steel sampling pole with sample collection bottle	Maruya et al. (2018)
Triclocarban	Freshwater		Individual Bottle by pole sampler	Grab sample - stainless steel sampling pole with sample collection bottle	Maruya et al. (2018)
Bisphenol A	Freshwater		Individual Bottle by pole sampler	Grab sample - stainless steel sampling pole with sample collection bottle	Shimabuku, Sun, and Trowbridge (2017)
Total organic carbon	Sediment		Van Veen grab samplers, 0.1 m^2 modified stainless steel coated with Kynar (jaws and doors). Use sample bottle to scoop sediment directly from the center of the device without touching the device.	Composite	

Name	Matrix	Notes	Collection Device	Collection Method	Source
PBDE 047	Sediment	Avoid plastics; teflon ok; metal ok; trace cleaned glass ok	Van Veen grab samplers, 0.1 m² modified stainless steel coated with Kynar (jaws and doors). Use sample bottle to scoop sediment directly from the center of the device without touching the device.	Composite	Shimabuku et al. (2018)
PBDE 099	Sediment	Avoid plastics; teflon ok; metal ok; trace cleaned glass ok.	Van Veen grab samplers, 0.1 m² modified stainless steel coated with Kynar (jaws and doors). Use sample bottle to scoop sediment directly from the center of the device without touching the device.	Composite	Shimabuku et al. (2018)
PFOS	Sediment	Avoid teflon sampling equipment/gear.	Van Veen grab samplers, 0.1 m² modified stainless steel coated with Kynar (jaws and doors). Use sample bottle to scoop sediment directly from the center of the device without touching the device.	Grab	Shimabuku et al. (2018)
PFOA	Sediment	Avoid teflon sampling equipment/gear.	Van Veen grab samplers, 0.1 m² modified stainless steel coated with Kynar (jaws and doors). Use sample bottle to scoop sediment directly from the center of the device without touching the device.	Grab	Shimabuku et al. (2018)
PBDE 047	Bivalve	Avoid plastics; teflon ok; metal ok; trace cleaned glass ok	Clam dredge	Composite	
PBDE 099	Bivalve	Avoid plastics; teflon ok; metal ok; trace cleaned glass ok	Clam dredge	Composite	

Name	Matrix	Notes	Collection Device	Collection Method	Source
PFOS	Bivalve	Avoid teflon sampling equipment/gear.	Clam dredge	Composite	
PFOA	Bivalve	Avoid teflon sampling equipment/gear.	Clam dredge	Composite	
PBDE 047	Fish	Avoid plastics; teflon ok; metal ok; trace cleaned glass ok	Various methodologies include hook & line, electrofishing, seining, gill netting.	Composite	
PBDE 099	Fish	Avoid plastics; teflon ok; metal ok; trace cleaned glass ok	Various methodologies include hook & line, electrofishing, seining, gill netting.	Composite	
PFOS	Fish	Avoid teflon sampling equipment/gear.	Various methodologies include hook & line, electrofishing, seining, gill netting.	Composite	
PFOA	Fish	Avoid teflon sampling equipment/gear.	Various methodologies include hook & line, electrofishing, seining, gill netting.	Composite	

12. Sample Handling and Custody

The following sample handling and transportation protocols will be carried out by field crews from the respective field sampling agencies. Field sampling sheets will be created by an MLJ staff person (environmental analyst or someone from data management) at the start of each year for each matrix. Field sampling crews can use their own field sampling sheet as long as it includes the same essential information. As applicable, certain information will be included in the field sheet such as:

- Sampling location
- Sampling coordinates and datum
- Unique bottle ID for each discrete analysis
- Preservation required (chemical and strength)
- Preservation location (field, laboratory etc)
- Preservation completion date and time (if done in the field)
- Date and time of collection for each bottle or aliquot
- Any comments that will aide in data interpretation

Field data and information will be transferred by field sampling laboratory personnel into an electronic format and paper copies kept in a field binder for reference. Samples will be handled and stored per the analytical method requirement. **Table 12-1** provides information about storage and hold time requirements for each type of water quality measurement. The table lists how samples shall be physically handled, transported, received, and stored in the laboratory or office, including temperature upon receipt) and analytical and preservation hold times adhered to.

Sediment samples collected by the SPoT program and water samples collected by AMS will be dropped off at the MLJ office on the same day samples are collected.

When samples are ready for shipment, staff shall follow the MLJ shipping protocol. A summary of the water and sediment shipping process is described here.

- If shipments contain either acid (in greater than de minimis volumes) or dry ice, that shall be declared on the shipping label; consult with laboratory to determine de minimis volumes.
- Hold times, shipping times, and weekends will be taken into account when deciding when to ship. Never ship on a Thursday or Friday, unless absolutely necessary, to avoid

shipping over the weekend. If possible, ship on a Monday or Tuesday to allow a cushion of extra weekdays shall something go wrong with the shipment.

Inventory Samples & Create COCs

- All samples shall be logged into the refrigerator/freezer upon return from the field to ensure all samples are accounted for.
- Create and fill in shipment COCs. Include the analyzing lab's shipping address and contact information, laboratory contract number, and the billing code for shipment.
- Create a line on the COC for each sample (only one line is used for samples that include multiple containers - just be sure to indicate the number of containers in the appropriate column and only check the "Included" box once all samples have been added) noting the analysis expected, the matrix, any added preservative, sample bottle size and material, collection date and time, and any other information pertinent to the sample.
- Make a copy of the final COC and store in the appropriate electronic project folder.
- Send the final COC, via email, to the analytical laboratory representative to notify them of the shipment and expected samples.

Instructions for Packing the Shipment

- Laboratory supplied packaging material should be used whenever possible. If this is not possible, check with the project manager to ensure that proper packaging materials are being used.
- On the COC, double check that all samples are included in the shipment. For all bottles, ensure lids are tightly sealed. Apply enough bubble wrap around glass items to ensure that no hard edges can be felt through the bubble wrap. Bubbles shall be turned "in" toward the container. Ensure that there's ample bubble wrap on the lids as this can be an access point for breaking bottles. Place all bottles upright in the box or cooler (note: for larger glass bottles (1.0 L or bigger) preference is to ship in insulated styrofoam containers such as ColdIce), and fill in the remaining space with enough packing materials to ensure that they remain in place. Once complete, place the COC on top of the inside of the shipment (place the COC inside a ziploc bag; care should be taken if using waterproof paper to ensure that it does not include PFAS).
- Enter in the shipping information on the FedEx website to order a pick up and create shipping labels.
- Place the shipping labels in the shipping slip.
- Place the fragile stickers (glass shipments only) and shipping labels on the package on all sides.
- Review all shipments, make sure that COCs match the bottles in the box and the package is addressed to the correct lab. Get review from the project manager prior to sealing boxes.

- Tape the boxes/coolers shut. For coolers, the lid shall be taped down in both directions (lengthwise over the handles and widthwise).

Table 12-1. Storage and hold time requirements for each parameter group.

Parameter group	Lab	Sample Container	Initial Preservation/Storage	Extraction/ Preparation Hold Time	Analysis Hold Time[1]	Notes
Fish and Bivalve Tissue						
PBDEs	SGS-AXYS	4 oz amber glass jar, Teflon lined.	< -10°C dark	365 days	40 days	
PFAS	SGS-AXYS	4 oz HDPE jar, unlined.	< -10°C dark	NA	365 days	
Sediment						
PBDEs	SGS-AXYS	4 oz amber glass jar, Teflon lined.	< -10°C dark	365 days	40 days (not to exceed 365 days from sample collection)	
PFAS	SGS-AXYS	4 oz HDPE jar, unlined.	< -10°C dark	NA	365 days	
Total Organic Carbon	Weck	4 oz clear glass jar, Teflon lined.	< 6°C dark	NA	28 days	
Water						
PPCPs	Weck	2 x 250 mL amber glass	Preserve with sodium azide (200 mg) and Ascorbic acid (100 mg); store at <6°C	28 days	40 days	2 bottles are needed for particular QAQC samples; preserved with Sodium azide, Ascorbic acid
PPCPs (galaxolide and triclocarban)	Physis	2 x 1.0 L amber glass (clear glass may be used if samples are protected from light)	<6°C	7 days	40 days	Recommend to ship w/in 48-72hrs. Lab will preserve with sodium thiosulfate only if residual chlorine is present.
PFAS	Vista	HDPE or polypropylene bottle or jar	<10°C	28 days	30 days	

Parameter group	Lab	Sample Container	Initial Preservation/Storage	Extraction/ Preparation Hold Time	Analysis Hold Time[1]	Notes
Suspended Sediment Concentration	Weck	1.0 L polycarbonate bottle	<6°C	NA	14 days	

[1]Analysis hold time requirements begin from the initiation of the sample extraction/preparation process.

12.1. Chain of Custody Form

A Chain of Custody (COC) record is a legal record that documents the custody of the sample from collection to analysis. The COC record documents the collection of the samples and the progression of samples as they are transferred from the original sampling location to the laboratory performing the analysis and include information such as the sample collector, field analysis results, date and time of collection, preservation, date and time of receipt by the laboratory, and temperature at the time of receipt by the laboratory.

An example COC form is shown in **Appendix B**. The COCs for this study will be created by SFEI-ASC. A field agency will use its own COC as long as it contains fields for all of the necessary information:

- Project Name
- Sample ID
- Sampled by: Name, Signature
- Date/Time of sampling
- Matrix
- Container Type
- Analyses Requested
- Notes/Remarks
- Relinquished by: Name, Signature
- Date, Time relinquished
- Received by: Name, Signature
- Date, Time Received
- Shipping information:
- Date shipped
- Courier
- Number of coolers
- Cooler temperature
- Field for notes, comments, or remarks.

Field crews will drop off samples at the MLJ Office for shipment to the respective laboratories; except fish samples which will be delivered to MPSL-DFW for dissection. The COC forms will be left with the samples and receiving staff will confirm all samples are in the coolers and ensure that samples are packed and ready for shipment, if applicable. Both the field crew dropping off the samples and the staff receiving the samples will sign the COC form. Prior to sending the COC in the cooler, the signed COC will be scanned, and electronic copies saved on the MLJ server. Copies of fish COCs will be emailed to MLJ staff. Once the samples are received by the laboratory, the receiving staff will check the samples and sign the COC as the final

recipient. The project manager will be notified of any deviations from what is on the COC and what is received immediately upon receipt; the project manager must communicate any deviations to the CVRWQCB QA Representative. The final signed COC will be included with the laboratory report.

Sample Labeling

A stick-on sample label or a tag shall be completed for each sample container using waterproof, non-erasable ink. Labels should be covered in clear plastic tape to ensure labels stay adhered t the container during shipment. Sample numbers shall be written on sample containers and entered on COC forms. Specifics regarding fish tissue labeling can be found in MPSL-102a.

Sample ID and Labels

The sample ID will be used to identify the unique time and location at which a particular sample is taken.

Field crews will use pre-printed labels for each site (**Figure 7**). The label should already include the SampleID, laboratory, sample matrix, sample analyses, container type and container number. The sampler should complete:

- Sample date,
- Sample time, and
- Sampler initials (Collected By).

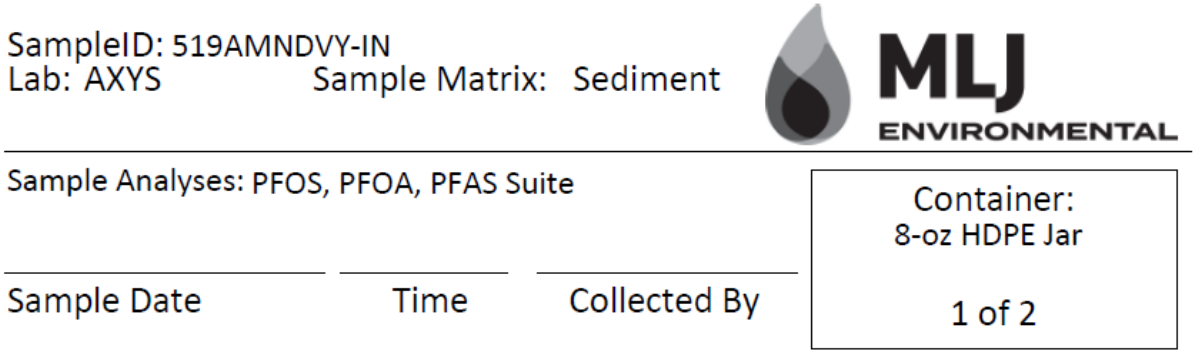
Samplers will complete the printed label with a ball point pen (Sharpies are not to be used with CEC sampling) before collecting the sample and cover the entire label with a piece of clear tape to prevent peeling. Samplers will use the mm/dd/yy format for the date and 24-hour time for the sample time rounded to the nearest 10 minutes. For example, a sample collected at 9:52 would have the sample time on the label and COC form rounded to 9:50; a sample collected at 9:55 or 9:57 would be rounded to 10:00. Arrival and departure times do not need to be rounded.

The SampleID will consist of the CEDEN Station code followed by the type of sample being collected (2 digit sample type code): [CEDEN StationCode][SampleType].

Sample type codes include the following:

- GR – grab samples
- GR2 – field duplicate for a grab sample
- IN – integrated samples (sediment)
- IN2 – field duplicate for an integrated sample
- CO – samples to be used for a composite
- FB – field blank

Figure 7. Example of prepopulated sample label.



Sample Retention and Disposal

Analytical laboratories shall retain samples for one year after analysis, consult with project manager before disposing of samples, and relinquish samples for transfer to long-term storage facility upon request.

Samples shall be disposed of following good laboratory practices and in compliance with health and safety standards.

13. Analytical Methods and Field Measurements

13.1. Field Measurements

The field collection teams will record measurements performed in the field on field sheets (electronic or paper), which will then be entered into the CV RDC through the eDERS data entry forms.

13.2. Laboratory Analysis

The following sections list the laboratory analytical methods that will be used in Delta RMP monitoring, and policies for sample archiving and disposal.

13.2.1. Analytical Methods

Table 13-1 provides a summary of analytical methods and instruments used in the Delta RMP. All of the laboratory analytical methods used in this study are either standard methods defined by the EPA or the APHA (described in *Standard Methods for the Examination of Water and Wastewater*), or laboratory-specific modifications of these methods.

Full or redacted (to protect confidential business information) versions of many of the analytical method SOPs can be requested from the project manager or QA Officer. All methods and SOPs

will be provided in unredacted form to the QA Officer for the State Water Resources Control Board (State Board) for review and approval, but the State Board QA Officer will not share them with anyone else. The labs will provide information on methods and SOPs to TAC members upon request, and can provide full descriptions if TAC members sign nondisclosure agreements.

Table 13-1. Summary of analytical methods and instruments.

Matrix	Lab	Parameter group	Methods	Instrument
Water	Weck	PPCP – Hormones	LC/MS/MS-APCI and EPA 1694M-APCI	*Pending, information requested from Weck*
Water	Weck	PPCP – Pharmaceuticals	LC/MS/MS-ESI and EPA 1694M-ESI-	*Pending, information requested from Weck*
Water	Physis	PPCP – Galaxolide (HHCB) and triclocarban	By GC/MS. (Modified EPA 625.1)	GC column - J&W DB5, 60 meter, 0.25mm ID, 0.25µm Film Thickness Capillary Column. Mass spectrometer - Capable of repetitively scanning from 35-450 Daltons (amu) every two seconds or less, utilizing a 70 eV (nominal) electron energy in the electron impact ionization mode,
Water	Weck	Ancillary – Suspended Sediment Concentration	Dried at 103-105 degrees C. (ASTM D3977-97)	*Pending, information requested from Weck*
Water	Weck	Conventional – Total Organic Carbon	Measured using a carbonaceous analyzer. (EPA 9060M)	*Pending, information requested from Weck*
Sediment; Tissue - Fish, Clam	SGS-AXYS	Flame Retardant – PBDE	By high resolution GC/MS. (SGS AXYS MLA-033)	Micromass Ultima mass spectrometer (MS) equipped with a Hewlett Packard 5890 or 6890 gas chromatograph, running Micromass software. A DB-5HT capillary chromatography column (30 m, 0.25 mm i.d. x 0.1 m film thickness) is coupled to the MS source.
Sediment; Tissue - Fish only	SGS-AXYS	Perfluoranate – PFOS and PFOA	By liquid chromatography/mass spectrometry (LC-MS/MS). (SGS AXYS MLA-110)	UPLC (ultrahigh performance liquid chromatography) reversed phase C18 column using a solvent gradient. The column is coupled to a triple quadrupole mass spectrometer run at unit mass resolution in the Multiple

Matrix	Lab	Parameter group	Methods	Instrument
				Reaction Monitoring (MRM) in negative electrospray ionization mode.

13.2.2. Sample Archive and Disposal

Project samples shall not be disposed of until all analyses are complete and analytical and QC results have been reviewed and approved by the CEC Project Manager and the QAO.

14. Quality Control

This section describes quality control activities, what shall be done when control limits are exceeded, and how corrective actions will be assessed and documented.

14.1. Field Measurements

Prior to use in the field (preferably within 24 hours prior to sampling), handheld water quality instruments are calibrated against appropriate standards and, if possible, checked against a standard from a different source. For some measurements such as dissolved oxygen, probes are often calibrated to ambient conditions rather than to known standards. In such cases, the field staff shall verify appropriate qualitative instrument response (e.g., in water deoxygenated by sparging, sodium sulfite addition, or other means). All calibrations are documented on a calibration checklist on the individual instrument or its case with date, time, and operator name. If an instrument cannot be calibrated or is not reading correctly, a backup instrument will be used to measure water quality parameters.

Table 14-1 shows the measurement quality objectives for field parameters.

For single or multi-parameter water quality meters, the following standards will be used to calibrate:

1. **pH** – commercially available standards pH 4, 7, 10. Perform a 2-point calibration covering the range of expected measurements. Use the 3rd pH standard (or standard supplied by another manufacturer) as a check standard to verify calibration accuracy.
2. **Specific Conductance** – perform a single-point calibration in the middle of the expected environmental range and use two check standards (KCl solution) bracketing the expected measurement range.
3. **Dissolved oxygen** – use calibration procedure recommended by the manufacturer, typically in 100% air saturation.

4. **Temperature** – check against a thermometer of known accuracy before each deployment. An ice water bath of approximately 0°C can be used to semi-quantitatively verify temperature probe response but will vary due to uncontrolled factors such as container size and geometry, ice/water disequilibrium, or the presence of melting point-lowering constituents.

5. Turbidity - blank check within 24 h before sampling and at the end of the sampling event. Calibration check within 24 h before sampling.

Table 14-1. Measurement quality objectives for field parameters.

Instrument	Parameters	QC check	Matrix	Frequency	Acceptable limits
YSI ProDSS (or similar)	Oxygen, Dissolved	Calibration	Sample water	Calibration in oxygen saturated water, Daily prior to use.	Accuracy ±.0.5
YSI EXO ProDSS (or similar)	pH	Calibration	Sample water	Blank check within 24 h before sampling and at the end of the sampling event Calibration check within 24 h before sampling. Temperature check with NIST certified thermistor - every 6 months	Accuracy: ±0.2%
YSI EXO ProDSS (or similar)	Specific Conductivity	Calibration	Sample water	Blank check within 24 h before sampling and at the end of the sampling event Calibration check within 24 h before sampling. Temperature check with NIST certified thermistor - every 6 months	Accuracy: ±2.0%
YSI EXO ProDSS (or similar)	Temperature	Calibration	Sample water	Calibration at 6, 20, and 40 Celsius	Accuracy: ±0.2%
YSI EXO ProDSS (or similar)	Turbidity	Calibration	Sample water	Blank check within 24 h before sampling and at the end of the sampling event Calibration check within 24 h before sampling. Temperature check with NIST certified thermistor - every 6 months	Accuracy/bias: ±1.0 %

14.2. Laboratory Analysis

The Laboratory Project Manager must submit to the CEC Project Manager and QA Officer information demonstrating and documenting that the method's performance meets the data quality requirements of the project. Two separate factors are involved in demonstrating method applicability: first, demonstrating that the laboratory can perform the method properly in a clean matrix with the analytical system under control, and second, demonstrating that the method selected generates "effective data" in the matrix of concern. The former addresses laboratory or operator training and proficiency, while the latter demonstrates that the selected method performs with the appropriate selectivity, sensitivity, lack of blank contamination, accuracy, and precision, in the actual analytical matrix, to achieve project measurement quality objectives.

The QAO or delegated staff member will assign quality assurance data flags (QA codes) to results that fail to meet the measurement quality objectives (MQOs). The threshold for assigning rejection quality assurance flags for each analyte to all environmental results on a project or dataset level is set at **twice the acceptance limit**. More information on how DMT staff perform QA and apply flags to data can be found in the **Surface Water Data Management Standard Operating Procedures**.

14.2.1. Measurement Quality Metrics

Laboratory Performance Measurements for Laboratory Analyses

Laboratory performance measurements are included in the QA data review to check if measurement quality objectives are met. Results of analyses of QC samples are to be reported with results of field samples. Minimum frequencies and target performance requirements for QC measures of reported analytes are specified in **Table 14-2**. Laboratories are free to perform additional QC in accordance with their standard practices.

QC measures typically used for evaluation of laboratory and field sampling performance include the following (not all are possible/available for all matrices; required types for each analysis are listed in **Table 14-2**):

1. **Laboratory method blanks**: samples of a clean or null (e.g., empty container) matrix taken through the entire analytical procedure, including preservatives, reagents, and equipment used in preparation and quantitation of analytes in samples, to assess contamination introduced in laboratory processes.
2. **Field blanks**: samples of a clean or null matrix taken through the sampling procedure, then analyzed much like an ordinary field sample to assess contamination introduced in the field superimposed on any existing laboratory method blank contamination.

3. **Laboratory duplicates**: replicate sub-samples of field samples, taken through the full analytical procedure including all laboratory processes combined, to measure analytical precision. Although standard reference materials, laboratory reference materials, matrix spike samples, or laboratory control samples can also be analyzed in replicate, references to those are prefaced by their sample type name, e.g., “matrix spike duplicates”.
4. **Field duplicates**: samples collected identically to the primary field samples at a site, used to assess spatial or temporal heterogeneity in the sampled matrix, superimposed on any existing laboratory analytical variation.
5. **Surrogate standards**: analytes introduced to samples prior to sample extraction to monitor sample extraction method recoveries.
6. **Laboratory control samples:** samples of a clean or null matrix spiked with target analytes, then analyzed much like an ordinary field sample, used to assess accuracy of the analytical method.
7. **Matrix spike samples/duplicates**: field samples to which known amounts of target analytes are added, indicating potential analytical interferences present in field samples, and errors or losses in analyses not accounted for by surrogate correction.
8. **Certified Reference Materials:** natural matrix samples with externally validated "certified" concentrations of analytes of interest, usually obtained from commercial or government vendors (e.g., NIST, which calls them "SRMs" (standard reference materials)). Often analyzed across multiple analytical batches, to track drift or shifts in analytical accuracy and precision.
9. **Laboratory reference materials**: materials collected, bought, or created by a laboratory as internal reference samples, to track performance across batches.

Table 14-2. Measurement quality objectives for laboratory measurements.

Method	Sample type	Matrix	Frequency	Acceptable limits (MQO)
PPCP – Hormones				
LCMSMS-APCI and EPA 1694M-APCI	Field Blank	Water	1 per 20 samples (with one coming from each field collection crew)	Less than the MDL for target analytes
LCMSMS-APCI and EPA 1694M-APCI	Field Duplicate	Water	1 per 20 samples (with one coming from each field collection crew)	RPD ≤ 35%; n/a if concentration of either sample < MDL
LCMSMS-APCI and EPA 1694M-APCI	Laboratory Blank	Water	1 per batch	Less than the MDL for target analytes
LCMSMS-APCI and EPA 1694M-APCI	Laboratory Control Sample/Duplicate	Water	1 per batch	70-130% recovery if certified; otherwise, 50-150% recovery; RPD ≤25%.
PPCP – Pharmaceuticals				
LCMSMS-ESI and EPA 1694M-ESI-	Field Blank	Water	1 per 20 samples (with one coming from each field collection crew)	Less than the MDL for target analytes
LCMSMS-ESI and EPA 1694M-ESI-	Field Duplicate	Water	1 per 20 samples (with one coming from each field collection crew)	RPD ≤ 35%; n/a if concentration of either sample < MDL
LCMSMS-ESI and EPA 1694M-ESI-	Laboratory Blank	Water	1 per batch	Less than the MDL for target analytes
LCMSMS-ESI and EPA 1694M-ESI-	Laboratory Control Sample/Duplicate	Water	1 per batch	70-130% recovery if certified; otherwise, 50-150% recovery; RPD ≤25%.
PPCP – Galaxolide (HHCB) and triclocarban				
EPA 625.1M	Field Blank	Water	1 per 20 samples (with one coming	Less than the MDL for target analytes

Method	Sample type	Matrix	Frequency	Acceptable limits (MQO)
			from each field collection crew)	
EPA 625.1M	Field Duplicate	Water	1 per 20 samples (with one coming from each field collection crew)	RPD ≤ 35%; n/a if concentration of either sample < MDL
EPA 625.1M	Laboratory Blank	Water	1 per batch	Less than the MDL for target analytes
EPA 625.1M	Laboratory Control Sample	Water	1 per batch	70-130% recovery if certified; otherwise, 50-150% recovery
EPA 625.1M	Matrix Spikes/Duplicates	Water	1 per batch	50-150% or based on historical laboratory control limits; RPD ≤25%. n/a if concentration of either sample < MDL
Perfluoranate – PFOS and PFOA				
EPA 537M	Field Blank	Water	1 per 20 samples (with one coming from each field collection crew)	Less than the MDL for target analytes
EPA 537M	Field Duplicate	Water	1 per 20 samples (with one coming from each field collection crew)	RPD ≤ 35% ; n/a if concentration of either sample < MDL
EPA 537M	Laboratory Blank	Water	1 per batch	Less than the MDL for target analytes
EPA 537M	Lab Duplicate	Water	none	NA
EPA 537M	Laboratory Control Sample/Duplicate	Water	1 per batch	70-130% recovery if certified; otherwise, 50-150% recovery; RPD≤30%.

Method	Sample type	Matrix	Frequency	Acceptable limits (MQO)
EPA 537M	Matrix Spikes/Duplicates	Water	none	NA
Ancillary – Suspended Sediment Concentration				
ASTM D3977-97	Field Blank	Water	1 per 20 samples (with one coming from each field collection crew)	Less than the MDL for target analytes
ASTM D3977-97	Field Duplicate	Water	1 per 20 samples (with one coming from each field collection crew)	RPD ≤ 35%; n/a if concentration of either sample < MDL
ASTM D3977-97	Laboratory Blank	Water	1 per batch	Less than the MDL for target analytes
ASTM D3977-97	Lab Duplicate	Water	1 per batch	RPD ≤ 35%; n/a if concentration of either sample < MDL
ASTM D3977-97	Laboratory Control Sample	Water	1 per batch	70-130% recovery if certified; otherwise, 50-150% recovery
Flame Retardant – PBDE				
SGS Axys MLA-033 Rev 06	Field Blank	Sediment	n/a	Field blanks not typically collected for sediment
SGS Axys MLA-033 Rev 06	Field Duplicate	Sediment	1 per 20 samples (with one coming from each field collection crew)	RPD ≤ 35% ; n/a if concentration of either sample < MDL
SGS Axys MLA-033 Rev 06	Field Blank	Tissue	n/a	There is no way to collect a field blank of tissue samples
SGS Axys MLA-033 Rev 06	Field Duplicate	Tissue	n/a	Not practical to collect a field duplicate for tissue samples
SGS Axys MLA-033 Rev 06	Laboratory Blank	Tissue and Sediment	1 per batch	Less than the MDL for target analytes

Method	Sample type	Matrix	Frequency	Acceptable limits (MQO)
SGS Axys MLA-033 Rev 06	Lab Duplicate	Tissue and Sediment	1 per batch	RPD ≤ 35%; n/a if concentration of either sample < MDL
SGS Axys MLA-033 Rev 06	Laboratory Control Sample/Duplicate	Tissue and Sediment	1 per batch	70-130% recovery if certified; otherwise, 50-150% recovery; RPD ≤35%.
Perfluoranate – PFOS and PFOA				
SGS Axys MLA-110	Field Blank	Sediment and Tissue	n/a	Not practical to collect field blanks for tissue or sediment
SGS Axys MLA-110 Rev 02	Field Duplicate	Sediment	1 per 20 samples (with one coming from each field collection crew)	RPD ≤ 35% ; n/a if concentration of either sample < MDL
SGS Axys MLA-110 Rev 02	Laboratory Blank	Tissue and Sediment	1 per batch	Less than the MDL for target analytes
SGS Axys MLA-110 Rev 02	Lab Duplicate	Tissue and Sediment	1 per batch	RPD ≤ 35%; n/a if concentration of either sample < MDL
SGS Axys MLA-110 Rev 02	Laboratory Control Sample/Duplicate	Tissue and Sediment	1 per batch	70-130% recovery if certified; otherwise, 50-150% recovery; RPD ≤35%.
Conventional – Total Organic Carbon				
EPA 9060M	Field Duplicate	Sediment	1 per 20 samples (with one coming from each field collection crew)	RPD ≤ 35% ; n/a if concentration of either sample < MDL
EPA 9060M	Laboratory Blank	Sediment	1 per batch	Less than the MDL for target analytes
EPA 9060M	Lab Duplicate	Sediment	1 per batch	RPD ≤ 35%; n/a if concentration of either sample < MDL

Method	Sample type	Matrix	Frequency	Acceptable limits (MQO)
EPA 9060M	Laboratory Control Sample	Sediment	1 per batch	70-130% recovery if certified; otherwise, 50-150% recovery
EPA 9060M	Matrix Spikes/Duplicates	Sediment	1 per batch	50-150% or based on historical laboratory control limits; RPD ≤25%. n/a if concentration of either sample < MDL
Conventional – Moisture				
	Field Duplicate	Sediment	1 per 20 samples (with one coming from each field collection crew)	RPD ≤ 35% ; n/a if concentration of either sample < MDL
	Lab Duplicate	Sediment	1 per batch	RPD ≤ 35%; n/a if concentration of either sample < MDL
Conventional – Moisture/Lipid				
	Lab Duplicate	Tissue	1 per batch	RPD ≤ 35%; n/a if concentration of either sample < MDL

14.2.2. Corrective Action Procedures

If chemical analytical laboratory results fail to meet the MQOs, the corrective actions in **Table 14-3** will be taken, and where samples are not reanalyzed, data will be reported flagged. Corrective actions will be documented, resolved, and followed-up on following the process for corrective actions outlined by SWAMP. The process is based on the SWAMP Corrective Action Form and is applied to sample results that fail to meet the technical and non-technical requirements of SWAMP and its associated projects.

The Project Manager and QAO will document the corrective actions taken and provide a summary at the Delta RMP Technical Advisory Committee Meetings, and to the CVRWQCB QA Representative, and to other interested parties as a part of the QA Report.

Table 14-3. Corrective actions procedures for analytical laboratories.

If a problem is found with this laboratory QC sample type	The following corrective action(s) will be taken
Method Blank	Reanalyze the blank to confirm the result. Investigate the source of contamination. If the source of the contamination is isolated to the sample preparation, the entire batch of samples, along with the new laboratory blanks and associated QC samples, should be re-prepared and/or re-extracted and analyzed. If the source of contamination is isolated to the analysis procedures, reanalyze the entire batch of samples. If reanalysis is not possible, the associated sample results must be flagged to indicate the potential presence of contamination.
Field Blank	Investigate the source of contamination. Potential sources of contamination include sampling equipment, protocols, and handling, as well as the lab analysis. The laboratory should report evidence of field contamination as soon as possible, so that corrective actions can be implemented. Samples collected in the presence of field contamination should be flagged.
Surrogate Recovery	Investigate if recovery is unacceptably low or high. With low surrogate recovery, lab may not detect the target analytes at low concentrations. With high surrogate recovery, the lab may overestimate the concentration of target analytes (or underestimate if results reported surrogate corrected). If all surrogate recoveries are poor, it may be a problem with the analytical method. A few individual poor surrogate results may indicate matrix interference. If recovery on LCS, MS, and CRM appears acceptable despite poor surrogate recovery (e.g., showing adequate accuracy through surrogate correction), the target analytes should be flagged, but no addition action may be needed. Discuss with the lab possible method modifications to improve recovery or reduce matrix interferences.
Calibration Verification	Reanalyze the calibration verification to confirm the result. If the problem continues, halt analysis and investigate the source of the instrument drift. The analyst should determine if the instrument must be recalibrated before the analysis can continue. All of the samples not bracketed by acceptable calibration verification must be reanalyzed.

If a problem is found with this laboratory QC sample type	The following corrective action(s) will be taken
Matrix Spikes/Matrix Spike Duplicates	The spiking level should be near the midrange of the calibration curve or at a level that does not require sample dilution. Reanalyze the matrix spike to confirm the result. Review the recovery obtained for the matrix spike duplicate. Review the results of the other QC samples (such as reference materials) to determine if other analytical problems are a potential source of the poor spike recovery.
Laboratory Control Sample (LCS)	If an LCS does not meet the acceptance criteria, there are usually problems with the laboratory method (e.g., imprecise aliquoting). Investigate, identify, and resolve the source of the bias. Samples need to be re-prepared and re-analyzed as samples with an acceptable LCS. If impossible, qualify reported data.
Laboratory Duplicate	Reanalyze the duplicate samples to confirm the results. Visually inspect the samples to determine if a high RPD between the results could be attributed to sample heterogeneity. For duplicate results due to matrix heterogeneity, or where ambient concentrations are below the reporting limit, qualify the results and document the heterogeneity.
Field Duplicate	Visually inspect the samples to determine if a high RPD between results could be attributed to sample heterogeneity. For duplicate results due to matrix heterogeneity, or where ambient concentrations are below the reporting limit, qualify the results and document the heterogeneity. All failures should be communicated to the Project Manager, who in turn will follow the process detailed in the method.

15. Instrument/Equipment Testing, Inspection, and Maintenance

15.1. Field Equipment

Field equipment such as boats, nets, and traps are inspected prior to each sampling event and are maintained throughout the field season and prior to storage during the off-season.

All field crews shall have extra Chain of Custody forms and a copy of this document or the relevant portions. Field crews will work in pairs at a minimum, for safety.

For water sampling, instrumentation and equipment used will generally be limited to sample collection and filtration apparatus. The filtration apparatus will be used and maintained in accordance with the manufacturer's instructions. Field meters will be calibrated following the manufacturer's instructions for each analyte of interest.

Minimum equipment for the respective project elements includes:

Water Sampling

- collection devices
- waders
- field water quality meter (YSI)
- bottles
- coolers and ice
- handheld GPS
- Maps of site locations
- Squeeze bottles of deionized water
- Nitrile gloves
- Pre-populated field sheets, labels and COC forms

Fish Sampling

- Boats (electro-fishing and/or for setting nets)
- Bone saw, gill nets (various sizes), filet knives, fish picks, shackles, pliers, sharpening stone
- Rod and reels, tackle box, landing net, live bait container
- Plastic ice chests, inflatable buoy, floats, anchor chains, anchors, patch kit
- Otter trawls (for sampling fish)
- Blocks
- Measuring boards, tape measure, id keys, non-Teflon cutting boards
- Coolers with ice
- Pre-populated field sheets, labels and COC forms

Clam Sampling

- Boat and trailer
- Life jackets
- Clam dredge
- Clam sample containers
- Calipers
- Forceps
- GPS unit
- field water quality meter (YSI)
- Pre-populated field sheets, labels and COC forms
- PPE (mask, foulies, boots)
- Coolers & dry ice
- Gloves (work and sampling)

- Misc (Clipboard, aluminum foil, Ziploc bags, ball point pens, duct tape, etc.)

Sediment Sampling

- van Veen sampler
- Polycarbonate core tubes
- Sampling scoops (stainless steel)
- Stainless steel bucket
- Coolers with ice
- Collection devices appropriate for site
- Field meters
- Coolers
- Squeeze bottles of deionized water and methanol
- Clean plastic scrub brush
- Nitrile gloves
- lab-grade detergent (Liquinox or equivalent)
- Pre-populated field sheets, labels and COC forms

15.2. Laboratory Equipment and Supplies

Contract laboratories maintain equipment in accordance with their respective SOPs, which include those specified by the manufacturer and those specified by the method.

Laboratories maintain internal SOPs for inspection and quality checking of supplies. Under a performance-based measurement system approach, these procedures are presumed to be effective unless field and QC data from analyses indicate otherwise. The CVRWQCB QA Representative, Project Manager, and QAO will then work with the laboratory to identify the causes and address deficiencies in the SOPs that resulted in those problems. If the problem is serious and cannot be corrected by the laboratory, CVRWQCB QA Representative, the Project Manager and QAO will discuss and identify alternatives, including changing the sampling materials and methods, the extraction and analytical methods, the laboratory, or any combination of these.

16. Instrument/Equipment Calibration and Frequency

16.1. Field Instruments/Equipment

Whenever an environmental water sample is collected, field crews shall collect basic water quality measurements using handheld measurement devices. Instruments for field data collection are described in **Section 14.1**, Quality Control, Field Measurements.

16.2. Laboratory Equipment

Laboratories maintain calibration practices as part of their method SOPs. Calibration procedures are described generally below.

All analytical measurement instruments and equipment used by the laboratories will be controlled by a formal calibration and preventive maintenance program. Each laboratory will require that equipment be of the proper type, range, accuracy, and precision to provide data compatible with specified requirements. All instruments and equipment that measure a quantity, or whose performance is expected at a stated level, are subject to calibration.

In addition, each laboratory's preventive maintenance program will include: a list of the instruments and equipment that will be used, the frequency of maintenance recommended by the manufacturer, and a list of the items to be checked or serviced during maintenance.

Upon initiation of an analytical run, after each major equipment disruption, and whenever on-going calibration checks do not meet recommended MQOs, the system will be calibrated with a full range of analytical standards. Immediately after this procedure, the initial calibration must be verified through the analysis of a standard obtained from a different source than the standards used to calibrate the instrumentation, prepared in an independent manner, and ideally having certified concentrations of target analytes (e.g., a certified solution). The calibration curve is acceptable if it has an R^2 of 0.995 or greater for all analytes present in the calibration mixtures. If not, the calibration standards, as well as all the samples in the batch, must be re-analyzed. All calibration standards will be traceable to an organization that is recognized for the preparation and certification of QA/QC materials (e.g., NIST, NRCC, U.S. EPA).

Calibration curves will be established for each analyte and batch analysis from a calibration blank and a multi-point calibration (as described or required in the method), covering the range of expected sample concentrations. Only data within the working calibration range (and above the MDL) shall be reported (i.e., extrapolation is not acceptable). Samples outside the calibration range will be diluted as appropriate and reanalyzed.

17. Inspection/Acceptance for Supplies and Consumables

17.1. Field Supplies and Consumables

All sampling supplies and consumables used for this project shall be purchased by the field agencies. The field supervisor and staff shall inspect the necessary supplies and consumables according to their SAP. Chemical-resistant powder-free nitrile or polyethylene gloves shall be worn during sample handling and collection, as appropriate. All supplies must be inspected prior to use, and examined for any damage.

All sample containers shall meet or exceed the required trace limits established by the U.S. EPA in the Section 10 of the document Specifications and Guidance for Contaminant-Free Sample Containers , EPA/540/R-93/051 (USEPA 1992).

17.2. Laboratory Supplies and Consumables

Contract laboratories maintain supplies in accordance with their respective SOPs, which include those specified by the manufacturer and those specified by the method.

18. Non-direct Measurements

As little to no data for the target CECs will be available in the Delta RMP study area, non-Delta RMP data will be used in determining ranges of expected concentrations in field samples and for calculations. This will include data from other monitoring studies conducted in California, elsewhere in the United States, or overseas. These data will be reviewed against the measurement quality objectives and used only if they meet all of the specified criteria (See **Section 14.2.1),** Measurement Quality Objectives). Data not meeting Delta RMP MQOs shall be used only in a qualitative manner for developing conceptual models and prioritizing future data needs and be qualified appropriately.

Hydrologic data (stage, flow, etc.) will be obtained from existing gauges and recorders located at or near designated monitoring locations. Only fully QA-reviewed hydrologic data will be used in analysis and reporting. Acceptable sources include the USGS National Water Information System (NWIS, https://waterdata.usgs.gov/nwis) and the DWR Water Data Library (WDL, http://wdl.water.ca.gov/waterdatalibrary/). Provisional data and modeled/forecasted data will be used for planning sampling events, for example determining whether there is sufficient rainfall and runoff forecasted to meet one of the event triggers described in **Section 10.2**.

19. Data Management

This section provides a brief overview of how project staff manage data generated by the project's sampling and analyses. For more detailed information, refer to the Surface Water Data Management Standard Operating Procedures (**Appendix A**).

19.1. Entering and formatting of sampling and QA data results

19.1.1. Reporting of field collection information

Collection information shall be recorded by field crews during sampling using field data sheets (**Figure 2**). Agencies will also record information electronically, so long as the risk of data loss is equivalent or less than for paper forms. Backups made as soon as possible after or during field collection (e.g., photos or scans of handwritten sheets, USB copies of electronic forms) are recommended.

MLJ staff will enter data directly in the CV RDC using the eDERS online webforms hosted by MPSL-MLML. The eDERS field data entry forms were developed based on SWAMP field sheets and include drop down lists from the valid lookup list tables to ensure CEDEN comparability. Scans or photos of the paper field data sheets (or electronic printouts of electronic forms) must be saved as digital PDF or image files on a secure server.

19.1.2. Reporting of field measurements and observations

Field measures and observations shall be reported by collection agencies to be entered into the CV RDC during field data entry. Field measures (e.g., pH, conductivity) and habitat observations (e.g., wind direction, air temperature) are entered through the eDERS online forms. See QAPP **Table 6-2** for required habitat parameters and **Table 7-3** for field measurements.

Once entered into the CV RDC, data are then re-exported and verified against the original field sheets to ensure accurate data entry. Once field data are entered and verified, the sample collection information is queried from the database and provided to the laboratories so that they can generate CEDEN-comparable EDDs.

19.1.3. Laboratory reporting of results

Chemical-analytical data shall be reported by laboratories in CEDEN's Water Quality (WQ) template. Tabulated data will include the following information for each sample (when applicable):

1. **Sample identification:** sample ID, site code, site name, collection date, collection time, analysis date, sample type (field or QC types), and matrix.
2. **Analytical methods:** Preparation, extraction, and quantitation methods (codes shall reference SOPs submitted with the data submission package). Also include preparation, extraction, and analysis dates.
3. **Analytical results**: Analyte name, fraction, result, unit, method detection limit (MDL), and reporting limit (RL) for all target parameters. The appropriate data qualifiers shall be submitted with the results.
4. **Batch and result comments**: Laboratory comments must be applied to any batch when any QA code was applied to a result in the batch that will affect data use. A brief explanation of the issue shall be included.

Required additional data include:

- Laboratory replicate results (and field replicates, when sent for analysis)
- Quality assurance information for each analytical chemistry batch:

- CRM, LRM, or LCS results: absolute concentrations measured, certified value, and percent recovery relative to certified or expected value.
- Matrix (or blank) spike results: include expected value (native + spike) for each analyte, actual recovered concentrations, calculated per recovery, and RPD.
- Method blank sample results in units equivalent to field sample results (e.g., if the field samples are reported as ng/g, method blanks are given in the same units). Laboratory replicate results and calculated RPD or RSD.

Documentation containing definitions, field length, field requirement, and associated lookup lists (if applicable) for each field is available on the CEDEN website (http://www.ceden.org/ceden_datatemplates.shtml). Fields requiring controlled vocabulary can be identified by hovering over the field name in the template and referring to the lookup list that is referenced. Lookup lists are available on the CEDEN website at http://www.ceden.org/CEDEN_Checker/Checker/LookUpLists.php.

Batches must be reviewed for QC completeness and any deviation in QC results shall be documented in the accompanying case narrative. The required fields will be identified in the template in green font. Each laboratory shall establish a system for detecting and reducing transcription and calculation errors prior to reporting data.

Only data that have met MQOs or that have deviations explained appropriately will be accepted from the laboratory. When QA requirements have not been met, the samples will be reanalyzed when possible. Only the results of the reanalysis shall be submitted, provided they are acceptable.

Reporting turnaround times for submission of results from sample analyses are specified in contracts with the analytical laboratories. However, samples shall be extracted and analyzed within the holding times specified for the analytical methods used (**Table 12-1**). Turnaround time requirements specified in subcontracts are generally 45 days or less for water and sediment, and 60 days or less for tissue matrices.

19.1.4. Discrete water quality sampling data

The laboratories provide discrete data to the DMT in appropriate CEDEN templates within the timeframe stipulated in the contract, usually 45 days (60 days for tissue) or less from receipt of sample. The laboratories shall use the current online data checker to review data for vocabulary and business rule violations prior to submitting. The DMT will work with the laboratories to address vocabulary and business rule issues identified from using the data checker. The DMT will work with CEDEN to populate the lookup lists with new values as identified by the laboratories from using the online data checker.

The laboratories shall report data as outlined in **Section 19.1.1**, Laboratory reporting of results. Data are maintained at MLJ. The DMT tracks each data set, from submittal to final upload to the RDC database. Once all expected data have been received, expert staff on the DMT process the data using a series of queries designed to identify any issues remaining with the format of the data. Preliminary data review (completeness checks and automated checking against MQOs) will occur as soon as results are received and within the time described in Attachment A of the Central Valley Water Board Resolution; any issues with format, QA/QC completeness or concerns with meeting MQOs are reported to the QAO, project manager, CVRWQCB QA Representative, and the laboratory. Deviations from the QAPP and status of data processing will be communicated to the TAC on a regular basis. The QAO or designee then reviews data for quality assurance and quality control and appropriate CEDEN QA codes are applied to the dataset. A Data Quality Assurance Report which assesses completeness, precision and accuracy will be drafted by the QAO and submitted to the TAC for review approximately three months after the final data set for the year is uploaded to the CV RDC. Public release through CEDEN will occur after the full annual dataset is accumulated and approved for release and within the timeframe listed in Attachment A of the Central Valley Water Board Resolution. An estimated timeline for this process is included in **Table 19-1.**

Table 19-1. Schedule of data management tasks and associated days expected to complete the task relative to specific events.

Event	Task	Days to Complete Task	Accumulated Business Days from Event
Receipt of field sheets	Field Data Entry	5	5
	Sample Details	5	10
Receipt of samples	Notification of Sample Delivery Issues	1	1
	Receipt of Laboratory PDF	30[1]	30
	Preliminary check of report for completeness	5	35
	Receipt of Laboratory EDD	45[1]	45
	Preliminary data to Delta RMP TAC	1	46
	Preliminary data to CVRWQCB		60 days from date of sample analysis
	Feedback to laboratory regarding any formatting, completeness or QC issues	10	55
	Laboratory data loaded into the CV RDC	10	65
	Finalized data to Delta RMP TAC	1	66
After data loading of last event	Data QA Report for Year 2 for TAC Review	90	90
	Data Published to CEDEN (pending Delta RMP approval)	30	within 6 months of the

Event	Task	Days to Complete Task	Accumulated Business Days from Event
			last sampling event date.

[1]Additional time may be added to receive reports when tissue sample homogenization is required prior to analysis.

Not all data generated by this project will be published to CEDEN, though all data will be stored and maintained in the CV RDC. As indicated in the Pilot Study Workplan, the results from source locations added to the monitoring design in Year 2 will not be marked for public release within the CV RDC and therefore will not be published to CEDEN. All data released to the public will be overseen and approved by the Steering Committee.

Data approved for public release by the Delta RMP Steering Committee are made available through CEDEN's Advanced Query tool. The contact individual for steps and tasks of data management is the project Data Manager, Cassandra Lamerdin.

The DMT maintains regular backups of their enterprise databases. All data residing on the MLJ Environmental server are backed up hourly to a local backup server. Local backups are moved to a cloud data center operated by an independent IT service provider and replicated to an additional data center each night. The CV RDC database resides on a server housed at the MPSL-MLML main laboratory server room. Server RDC-Gamma hosts both the CV RDC and MLML RDC database and connects to a second server (MLML-RDC) which hosts the Central Valley Checker System. Servers are monitored daily with weekly software maintenance and backed up nightly. Hardware maintenance occurs on an as needed basis. The most recent month of database backups are available for retrieval if needed; older backups are archived.

19.2. Laboratory data report package information

The laboratory's QA Officer is responsible for oversight and for guaranteeing the completeness and accuracy of submitted data. See **Section 4.3** for a list of the laboratory QA officers or their equivalent. Labs shall notify the CEC Project Manager of any change in personnel or contact information for the QAO or project manager.

Analytical results, including associated quality control samples (see **Section 14.2.1 Measurement Quality Metrics**), will be provided to the DMT by the analytical laboratories. The laboratories analyze samples according to the hold times listed in **Table 12-1**. The final report will be finalized for review within 30 days (or up to 60 days when tissue homogenization must also occur) after samples are received from the laboratory. Exceedances of the standard turnaround time shall be discussed with and approved by the CVRWQCB QA Representative, Delta RMP Project Manager and QAO.

Laboratory personnel will verify, screen, validate, and prepare all data, including QA/QC results, and will provide (upon request) detailed QA/QC documentation that can be referred to for an explanation of any factors affecting data quality or interpretation. Any detailed QA/QC data not submitted as part of the reporting package (see below) shall be maintained in the laboratory's database for future reference.

Laboratories will provide electronic copies of the tabulated analytical data in a format agreed upon with the Project Manager, Data Manager, or a designee.

Results shall be flagged by the laboratory for exceedances of Delta RMP MQOs for completeness, sensitivity, precision, and accuracy, using data quality codes as defined by CEDEN's list of QA codes, which have been adopted by the Delta RMP for reporting data. The data quality codes shall be provided in the LabResult table in the ResQualCode and QACode fields. A list of commonly used result qualifier codes is shown in **Table 23-1**. The most commonly used QA codes are shown in **Table 23-2**. A complete list of codes is available online at CEDEN's Controlled Vocabulary web page.

For a detailed description of the measurements and procedures that are used by the laboratory QA Officer and QA Officer to demonstrate the quality of reported data, see **Section 7**, **Quality Objectives and Criteria**.

19.3. Data storage/database

Data are managed by DMT staff under the supervision of the Data Manager and the Quality Assurance Officer. Upon completion of QA/QC review and data verification for the project year, data are compiled into the CV RDC database and distributed to the project managers.

Data will be released to the public upon verification in accordance with approved verification processes, and approval by the BOD (based on recommendation for approval by the Delta RMP Steering Committee) and in a timeframe that is consistent with Attachment A in the Board Resolution. For the water sampling, where there are multiple collection events per year, data will not be made publicly available until the full year's data has undergone verification. However, data will be loaded to the CV RDC and made publicly available based on the time schedule outlined in **Table 19-1**. Data approved for public release by the Delta RMP Steering Committee are made available through CEDEN's Advanced Query Tool webpage.

20. Laboratory Assessments and Response Actions

Before the monitoring project is initiated, a desktop review audit will be performed by the QAO and designated staff to determine if each laboratory can meet the requirements of the QAPP and to assist the laboratory where needed. A review to confirm the labs' claims on MDL, achievable recovery limits, precision of measurement, will be examined by requesting the

laboratory provide data on an anonymized other client sample batch, or from method development runs. Where the other data mismatches (e.g. MDLs much higher than promised) the QA officer will review their plans on how the laboratories will achieve it (e.g. use of larger subsamples, etc). Additional audits may be conducted at any time during the scope of the study. The QAO or designee will review every data file submitted as part of these audits and ensure that QC issues will be addressed as soon as they are detected. Results will be reviewed with participating laboratory staff and corrective actions recommended and implemented, where necessary. Furthermore, laboratory performance will be assessed through laboratory intercomparison studies (or "round robins") where available, such as those conducted by the National Institute of Standards and Technology (NIST).

If data quality issues are identified, a preliminary meeting will be held between the QAO, the Project Manager, the CVRWQCB QA Representative, and the laboratory QAO to discuss possible solutions. If necessary, a corrective action plan will be developed in consultation with the appropriate lab(s), the corrective actions taken, and the issue and its resolution summarized in a brief report or memorandum. If issues persist, the TAC and SC will be notified, and alternatives considered (e.g., a different lab, or deleting the analyte from the scope of the study for those analytes if no alternative laboratories are found). A summary of these issues will be maintained in the project files and will be noted in any reporting that includes affected data.

The QAO or Project Manager have the authority to issue stop work orders if there are major deficiencies that cannot be corrected.

21. Reports to Management

Annual Data QA Reports will be developed for this study, in order to document the activities of the program each year including an assessment of completeness, precision and accuracy, and to aid in adaptive management of the project.

The Annual Data QA Reports will present the results of the previous July-June fiscal year of sampling, and will include a QA summary by the QAO. The main purpose of these reports is to summarize the final data and results of the QA review. The QAO is responsible for summarizing potential QA issues with reported data and communicating those issues to the Project Manager; the project manager will communicate delays in data deliverables and/or QA issues to the CVWQCB QA Representative. The QAO also reviews any analyses and reports generated from the data, to ensure that QA issues are appropriately acknowledged in the presentation and interpretation of data. The QAO will prepare the QA summary annually, after completion of the QA review.

22. Data Review, Verification, and Validation

All Delta RMP data undergo review and evaluation to ensure that the data conform to quality criteria identified in this document (see Data Quality Indicators in **Section 7** and Laboratory Analysis Measurement Quality Objectives in **Section 14.2**) and other project-specific criteria. In addition, data are assessed to determine usability and whether the data support their intended use. Review of the data consists of three discrete but highly interlinked processes: verification, and validation, described in the next section (**Section 23**), and assessment, in **Section 24**.

The QA/QC requirements presented in the preceding sections are intended to provide a common foundation for each laboratory's protocols. The resultant QC data will enable assessment of the comparability and uncertainty of results generated by different laboratories, sampling entities, and analytical procedures. It shall be noted that the QC requirements specified in this plan represent the minimum requirements for any given analytical method; laboratories are free to perform additional QC in accordance with their standard practices.

23. Data Verification and Validation Methods

This section describes at a high level the CV RDC / MPSL-MLML process for verification and validation of reported environmental data. The DMT perform data verification following methods described in the Data Management and Quality Assurance Standard Operating Procedures (**Appendix A**).

23.1. Data Verification

In EPA guidance (EPA QA/G-8 2002), data verification is defined as "the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual requirements." Data are evaluated as meeting or failing MQOs, first by the laboratory, and again in data verification by the project QA Staff. In addition to contamination and other artifacts introduced by sampling and analytical methods, errors will arise at many points in the processing and transmittal of data generated for the Delta RMP. Characteristics of reported data are examined to identify possible problems in the generation and transmission of data.

Before submitting data, the contract laboratory's QAO performs checks of all of its records and the laboratory's Director or Project Manager will recheck 10%. All checks by the laboratory will be reviewed by DMT staff. Issues are noted in a narrative list and communicated to the field or laboratory teams as needed to correct any problems found (e.g. unanalyzed samples left in storage, transcription errors).

Labs shall submit data to the DMT in electronic form. Labs will send the results to the Data Manager after each round of analysis within the timeframe stipulated in the contract, usually 45

days or less. DMT staff will verify the completeness of the dataset after each submittal. The timeline associated with data verification and loading into the CV RDC are included in **Table 19-1.** The intent of this time schedule is to provide timely responses to the laboratory regarding any formatting, completeness or QA concerns identified when reviewing the laboratory report and/or electronic data in CEDEN templates. Preliminary results will be shared with the TAC as well as summaries of any deviations and status of any data management issues. The Quality Assurance Officer will prepare the QA summary for external distribution after each year's monitoring is complete.

DMT staff examines the data set for completeness (e.g., correct numbers of samples and analyses, appropriate QC sample data included) and accuracy (e.g., in sample IDs, using CEDEN vocabulary), and spot-checks for consistency with hardcopy results reported by the laboratory. DMT staff will examine submitted QC data for conformance with MQOs, specified previously (**Section 14.2.1**). Data that are incomplete, inaccurate, or failing MQOs without appropriate explanation will be referred back to the laboratory for correction and/or clarification.

The Project Manager and QAO will discuss data failing MQOs with laboratory staff to determine corrective actions and whether samples need to be reanalyzed or re-collected. If problems cannot be readily corrected (insufficient sample, irremovable interferences, or blank contamination), results outside the MQOs will be flagged using CEDEN codes appropriate for the specific deviations to alert data users to uncertainties in quantitation. **Table 23-1** shows the CEDEN controlled vocabulary for result qualifiers. **Table 23-2** shows the most frequently used CEDEN QA codes. A full list of QA codes that will be applied can be found online at CEDEN's Controlled Vocabulary web page.

Table 23-1. CEDEN controlled vocabulary for result qualifiers.

Result Qualifier Code	Result Qualifier Name
A	Absent
COL	Colonial
CG	Confluent Growth
DNQ	Detected Not Quantifiable
=	Equal To
JF	Field Estimated
>	Greater Than
>=	Greater than or equal to
<	Less Than
<=	Less than or equal to

Result Qualifier Code	Result Qualifier Name
NRS	No Reportable Sum
NRT	No Reportable Total
NSI	No Surviving Individuals
NA	Not Analyzed
ND	Not Detected
NR	Not Recorded
PR	Percent Recovery
P	Present

Table 23-2. Common CEDEN QA Codes.

QA Code	Description
BB	Sample > 4x spike concentration
BE	Low surrogate recovery; analyzed twice
BLM	Compound unidentified or below the RL due to overdilution
BRK	No concentration sample container broken
BRKA	Sample container broken but analyzed
BS	Insufficient sample available to follow standard QC procedures
BT	Insufficient sample to perform the analysis
BY	Sample received at improper temperature
BZ	Sample preserved improperly
CS	QC criteria not met due to analyte concentration near RL
CT	QC criteria not met due to high level of analyte concentration
D	EPA Flag - Analytes analyzed at a secondary dilution
DO	Coelution
DRM	Spike amount less than 5X the MDL
DS	Batch Quality Assurance data from another project
EU	LCS is outside of acceptance limits. MS/MSD are accept., no corr.
EUM	LCS is outside of control limits
FO	Estimated maximum possible concentration (EMPC)

QA Code	Description
GN	Surrogate recovery is outside of control limits
GR	Internal standard recovery is outside method recovery limit
H	A holding time violation has occurred
H24	Holding time was > 24 hours for Bacteria tests only
H6	Holding time was > 6 hrs but < 24 hours for Bacteria tests only
HH	Result exceeds linear range; concentration may be understated
HR	Post-digestion spike
HT	Analytical value calculated using results from associated tests
IF	Sample result is greater than reported value
IL	RPD exceeds laboratory control limit
IP	Analyte detected in field or lab generated blank
IU	Percent Recovery exceeds laboratory control limit
J	Estimated value - EPA Flag
JA	Analyte positively identified but quantitation is an estimate
LC	Laboratory Contamination
M	A matrix effect is present
N	Tentatively Identified Compound
NBC	Value not blank corrected
NC	Analyte concentration not certifiable in Certified Reference Material
NMDL	No Method Detection Limit reported from laboratory
None	None - No QA Qualifier
NRL	No Reporting Limit reported by the laboratory
PG	Calibration verification outside control limits
PJ	Result from re-extract/re-anal to confirm original MS/MSD result
PJM	Result from re-extract/re-anal to confirm original result
QAX	When the native sample for the MS/MSD or DUP is not included in the batch reported
R	Data rejected - EPA Flag

QA Code	Description
RE	Elevated reporting limits due to limited sample volume
SC	Surrogate Corrected Value
SCR	Screening level analysis

Table 23-3. CEDEN compliance codes.

DataCompliance Code	Description
Com	Compliant
DNU	Do Not Use
Est	Estimated
Hist	Historical
NA	Not Applicable
NR	Not Recorded
Pend	Pending QA review
Qual	Qualified
QualH	Qualified Historic
Rej	Rejected
Scr	Screening

Data are further assigned a batch verification code on a batch level. See **Table 23-4** for batch verification codes. When MQOs are not met, verification codes from the Batch Verification Lookup and/or QA Code Lookup tables will be applied by DMT staff or QAO and entered into the database. Codes applied by the QAO or designee are preceded by a "V" in the "Batch Verification Code" or "QA Code" fields. Individual records for field data and taxonomy, and laboratory batches for chemistry, tissue and toxicity will be coded "VAC" once verification is complete. This code is contained in the Batch Verification Code field.

If deviations from the MQOs are detected by DMT staff and applicable QACodes are not applied or incorrectly applied by the laboratory, DMT staff will adjust the QACode as per the QAPP. QACodes found to be missing will be added by the DMT staff without applying a "V" in front of the QACode. A "V" QACode is not utilized by the DMT staff since the DMT staff are working with the laboratory to ensure that the laboratory is applying the QACodes correctly as outlined in the QAPP. QACodes that are applied incorrectly by the laboratory will be removed by the DMT staff. Any QACode adjustment will be reviewed with the laboratory to ensure the

appropriate coding is utilized as per the QAPP for the current data set as well as to ensure future data sets are flagged correctly by the laboratory. The "V" QACodes will be utilized by the QAO in a later review, if needed.

The DMT staff will also adjust the LabSubmissionCode to ensure it is applied correctly by the laboratory. Batches with no QACodes other than "None" will receive an "A" LabSubmissionCode. Batches with any QACode other than "None" will receive an "A, MD" or applicable LabSubmissionCode, example if any QC is missing then a "QI" is applied. Overall, the DMT staff will work with the laboratory to ensure that QACodes and LabSubmissionCodes are applied correctly as per the QAPP. The BatchVerificationCode and the ComplianceCode will be applied by the QAO; therefore, the DMT staff will ensure that the BatchVerificationCode is "NR" and the ComplianceCode is "Pend".

The QAO will review the entire data set before the finalization of the data to ensure all QACodes are applied correctly. Any missing QACodes will be applied with a "V" by the QAO. Any QACodes that are incorrectly applied will be removed by the QAO and the DMT staff/laboratory will be notified. The QAO will not adjust the LabSubmissionCode. BatchVerificationCodes are updated by the QAO to denote the level of verification and to note incomplete data with missing QC. The QAO will apply the appropriate ComplianceCode (**Table 23-3)** to indicate the overall assessment of the data set. Any coding added by the QAO will be reviewed and discussed with the DMT staff and relevant laboratory to ensure future data sets are marked appropriately.

Table 23-4. Batch verification codes.

BatchVerification Code	BatchVerification Name
VAP	Alternate Level Validation
VAP,VI	Alternate Level Validation, Incomplete QC
VAP,VQI	Alternate Level Validation, Incomplete QC, Flagged by QAO
VAC,VR	Cursory Verification, Data Rejected - EPA Flag, Flagged by QAO
VAC,VMD	Cursory Verification, Minor Deviations, Flagged by QAO
VAC,VMD,VQI	Cursory Verification, Minor Deviations, Incomplete QC, Flagged by QAO
VAC	Cursory Verification
VAC,VQI	Cursory Verification, Incomplete QC, Flagged by QAO
VLC	Cursory Verification/Validation
VLC,VQI	Cursory Verification/Validation, Incomplete QC, Flagged by QAO
VLC,VMD	Cursory Verification/Validation, Minor Deviations, Flagged by QAO

BatchVerification Code	BatchVerification Name
VLC,VMD,VQI	Cursory Verification/Validation, Minor Deviations, Incomplete QC, Flagged by QAO
VR	Data Rejected - EPA Flag, Flagged by QAO
VAF	Full Verification
VAF,VQI	Full Verification, Incomplete QC, Flagged by QAO
VAF,VMD	Full Verification, Minor Deviations, Flagged by QAO
VLF	Full Verification/Validation
VQI	Incomplete QC, Flagged by QAO
VQI,VTC	Incomplete QC, Temporary Verificaton, Flagged by QAO
VMD	Minor Deviations, Flagged by QAO
VQN	No QC, Flagged by QAO
NA	Not Applicable
NR	Not Recorded
VTC	Temporary Verification

When batches are determined to be missing some or all QC required information, DMT staff will initiate communication with the laboratory to obtain this information, and will recommend corrective action so this information is included in future data deliverables. Each batch represents samples that were analyzed together under the same laboratory conditions (**Appendix A**). When MQOs do not exist for certain data types, the data Batch Verification Code is coded as "NA" ("Not Applicable").

Data from the first group of samples analyzed for each matrix will be reported as completed, to establish that all sampling, analysis, and reporting processes are performing as planned; after the first sampling group, data will be reviewed at a lower frequency as warranted (e.g., if no corrective actions appear likely necessary moving forward). However, new issues identified by the field or laboratory teams will be reviewed and addressed by the Project Manager and QAO mid-project as needed.

23.2. Data Validation

Decisions regarding data validation are still under discussion among stakeholders.

24. Data Assessment and Reconciliation with User Requirements

EPA (in EPA QA/G-9 2000) defines data quality assessment (DQA) as "the scientific and statistical evaluation of data to determine if data obtained from environmental data operations are of the right type, quality, and quantity to support their intended use." Procedures used to evaluate the uncertainty of the reported data are described in **Sections 7, 14, and 20-23**. Limitations on data use will be reported to the data users as validation and verification QA codes and comments in the CEDEN database (**Section 23**) and in Annual Monitoring Reports (**Section 21**). The monitoring reports are also central to the data quality assessment, as they report the results in the full context of the data needs of the program.

Measurement quality objectives listed previously (**Section 14.2.1**) establish targets to be routinely achieved by the analytical laboratory and field sampling. Data verification checks conformance to these targets, as well as achievement of project goals by field and laboratory teams in completeness and conformance to project protocols of collection of samples and reporting of data. Data validation uses the provided information to report on the overall accuracy or uncertainties in the data.

In data assessment, the project team reports the results in the context of the questions and other data needs for which the project was designed. However, it is uncertain whether obtained data, even when meeting all stated MQOs, will be sufficient to answer the Delta RMP management questions with sufficient certainty, as the relative contributions of environmental variability and analytical uncertainty to cumulative uncertainty (e.g. for use in modeling, comparisons to guidelines, or other functions) cannot be known *a priori* before sufficient data have been collected. However, as Delta RMP studies proceed, the ability of collected data to answer these management questions shall be periodically re-evaluated for study design and budget planning in subsequent years.

The project team will adaptively manage the study design to be cost-effective and to maximize the usefulness of the results to the water management community. For example, the laboratory analytical data will meet all MQO targets, but still not provide quantitative data for any field samples (e.g., all non-detects). These results are then evaluated in the context of project goals, using the observed results to make modifications in the project plan. A possible result is that the list of analytes will be modified based on monitoring results obtained during Years 1 and 2 of the pilot study, e.g., to look for additional metabolites, or a different class of compounds, if the expected analytes were not detected. Conversely, it might be decided that the likeliest or most toxic compounds in a given class have already been identified, and the lack of detects orders of magnitude below likely effects thresholds justify continued use of the same sampling and analytical methods, or discontinuing those analytes.

As the study proceeds, the project team will periodically re-evaluate the study design and budget for its ability to answer questions relevant to water managers. Any changes to the monitoring plan will be reviewed by the Delta RMP TAC recommended for approval by the Steering Committee to the BOD, reviewed and approved by the CVRWQCB, and updated within this CEC QAPP.

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Appendix A. Surface Water Data Management Standard Operating Procedures

STANDARD OPERATING PROCEDURES FOR SURFACE WATER DATA MANAGEMENT

REVISION 2.0

SEPTEMBER 1, 2021

Prepared by:

SOP for Surface Water Data Management revision history.

Revision No.	Revision Date	Person Responsible	Revision Description	Section(s) Affected
2.0	09/01/2021	L. McCrink	Update to MLJ Data Management Procedures to include updated checklists and tissue; addition of MIS procedures.	All

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LIST OF ACRONYMS

CEDEN	California Environmental Data Exchange Network
CV RDC	Central Valley Regional Data Center
COC	Chain of Custody
EDD	Electronic Data Deliverable
eDERs	Environmental Data Entry and Reporting System
eQAPP	Electronic Quality Assurance Project Plan
IRLP	Irrigated Lands Regulatory Program
LCS	Laboratory Control Spike
LCSD	Laboratory Control Spike Duplicate
LIMS	Laboratory Information Management System
MDL	Minimum Detection Limit
MLJ DMT	Michael L Johnson Data Management Team
MLML-MPSL	Moss Landing Marine Laboratories Marine Pollution Studies Laboratory
MQO	Measurement Quality Objective
MIS	Management Information System
MS SQL	Microsoft SQL Server
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PR	Percent Recovery
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RL	Reporting Limit
RPD	Relative Percent Difference
SOP	Standard Operating Procedures
SWAMP	Surface Water Ambient Monitoring Program
TIE	Toxicity Evaluation Identification
WQTL	Water Quality Trigger Limits
WY	Water Year

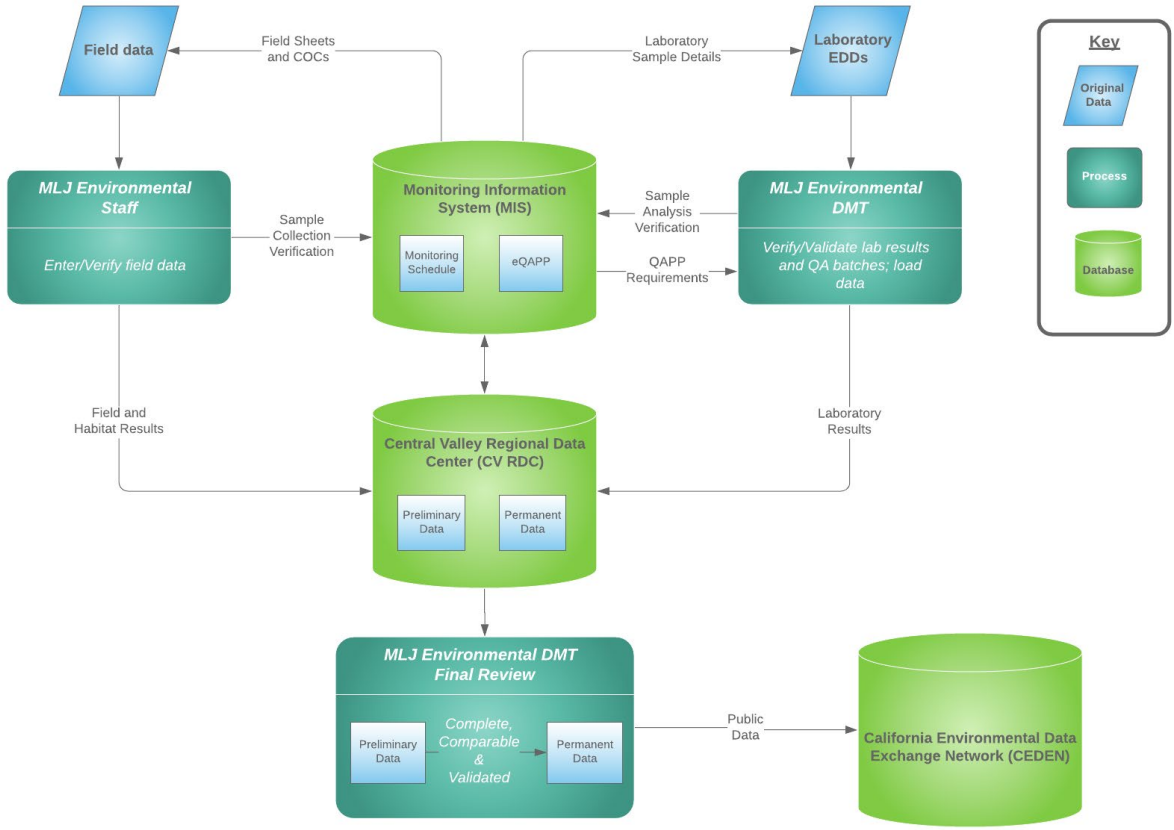
I. INTRODUCTION

The MLJ Environmental (MLJ) Standard Operating Procedures (SOPs) for Surface Water and Sediment Data Management describes the preparation, verification, quality control (QC), and processing of surface water, sediment, and tissue data completed by MLJ staff. Procedures outlined in this SOP apply to both chemistry and toxicity data.

A. PURPOSE

The following SOP outlines the procedures for the management of environmental quality data by MLJ Environmental. This document describes the general processes, minimum information requirements, and data verification procedures for field measurements and laboratory results, and the storage and management of those results in the Central Valley Regional Data Center (CV RDC) database. **Figure 1** is an illustration of the data flow from the receipt of data, through verification and quality control checks and finally uploaded and stored in relational databases managed by MLJ. Finalized data are transferred to the State Water Resources Control Board's (State Water Board) California Environmental Data Exchange Network (CEDEN) database when approved by the data provider.

Figure 1. Data flow diagram for water quality data (including sediment and tissue) managed in the CV RDC database and migrated to CEDEN.



B. DATABASES

There are three primary databases which are used throughout the data management process:

- ***Monitoring Information System (MIS Database)***. The MIS Database is an internal data management system managed and maintained by MLJ staff. The primary function of the MIS Database is to store and maintain programmatic information needed to manage and complete monitoring for various projects. Where necessary, data in the MIS are maintained in a format that is comparable to the CV RDC, allowing for monitoring data to be queried across both database systems for reporting purposes. There are two main elements of the MIS database that are used in different capacities throughout the data review and management process:
    - *Monitoring Schedule Database*: This element of the database stores scheduled sampling event details by project. The monitoring schedule is used to track samples collected and results received. Reports generated from this system are used to communicate the number of samples planned to be collected based on method and analyte to the laboratories and create field sampling materials including field sheets and chains of custody (COCs). It also stores information regarding the status and

completion of specific milestones for the processes outlined in this SOP such as completion dates for field data entry, laboratory deliverable receipt, and results loading into the CV RDC.

- *eQAPP Database*: This element of the database stores Measurement Quality Objectives (MQOs) and quality assurance requirements for each project. The term "eQAPP" refers to an electronic Quality Assurance Project Plan (QAPP). This part of the database serves as the official repository for current QAPP requirements by project.

- ***Central Valley Regional Data Center Database (CV RDC).*** The CV RDC is one of three Regional Data Centers in California that can migrate data to CEDEN which is managed by the State Water Board. The relational design of the CV RDC was developed with the intent to ensure that data submitted through this process are CEDEN comparable and meet CEDEN minimum requirements and business rules. The CV RDC is synced with CEDEN weekly to ensure comparability of lookup lists. Data within the CV RDC are not publicly available through CEDEN until they are verified and marked as public.
- ***California Environmental Data Exchange Network (CEDEN).*** This statewide water quality database is the repository for the public results of most surface water monitoring occurring in the State of California. It is maintained and managed by State Water Board staff; data in it are publicly available through http://ceden.org.

C. PERMISSIONS AND SECURITY

The MIS is a MS SQL database that is hosted on Amazon Web Services (AWS). Permissions to the MIS occur at the project level for specific clients upon request as well as to MLJ staff, as necessary.

The CV RDC database is a Microsoft (MS) SQL database which can be accessed online by using the Environmental Data Entry and Reporting System (eDERS) hosted by Moss Landing Marine Laboratories (MLML) or internally by MLJ Data Management Team (DMT) staff using MS SQL Management Studio or MS Access interfaces. All users are assigned a username and password for access to data. Permissions are unique to individual staff logins and are granted on the individual result record level (Row Level Security or RLS) based on RowSecurityIDs applied to every table and record in the database. Permissions are assigned by MLJ DMT staff when new projects or user logins are created in the database.

The CV RDC database is hosted on the MLML server, along with the MLML RDC; both databases are maintained as separate environments by the respective data management staff and do not share data or permissions. MLML staff cannot assign permissions to data within the CV RDC and cannot access CV RDC data unless permissions are assigned to them for specific results by MLJ DMT staff as needed for various projects (e.g. Delta RMP data review).

II. PROJECT DEFINITION

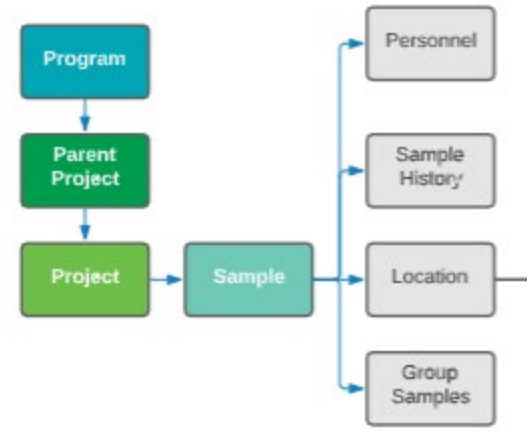
Certain elements of a monitoring project must be defined in the CV RDC Database before any results can be loaded or stored. High-level information associated with the project (Program Code, Parent Project Code, Project Code) and the sampling locations (Station Code, Target Latitude, Longitude, and datum) are required to be associated with any monitoring data in the CV RDC Database. Likewise, if elements of the monitoring program are managed by MLJ staff in the MIS Database, the same high-level project information stored in the CV RDC Database must also be within the MIS. Project definition information are stored in a comparable format between the MIS and the CV RDC such that data can easily be moved and queried between the two systems.

Data that are only being loaded directly to the CV RDC do not need to be defined in the MIS; however, at a minimum, the following fields must be populated in at least the CV RDC Database prior to loading any field or laboratory results.

- *Program Code.* The Program Code is the top tier of project definition information that can capture the requirements for initiating the project in the broadest sense, such as the regulatory program under which the project is required (e.g., Irrigated Lands Regulatory Program/ILRP).
- *Parent Project Code.* The Parent Project Code is the second tier of project definition information, further identifying the specific projects that operate within the defined program (e.g., specific coalitions under the ILRP, such as ILRP East San Joaquin Water Quality Coalition). For long term monitoring programs, the Parent Project Code should remain static as long as the monitoring is being conducted.
- *Project Code:* The Project Code associates surface water results with a higher-level Parent Project and Program Code. Project Codes can be used at the discretion of the Project Manager to logically combine samples in spatial or temporal groupings to meet programmatic needs. The Project Code also connects the station information and associated sampling results to the original workplan and monitoring schedules. When creating a Project Code, it is important to keep in mind that all data for a specific project code will be transferred at one time; therefore, Project Codes for long term projects often capture a specific time period that will be transferred in a single effort, such a quarter or a year.
- *Station Code*: The Station Code must be unique and reflects the station name; station codes can be no more than 25 characters. Whenever possible, station codes associated with data managed by the MLJ DMT should start with the 3-digit hydrologic unit code followed by six characters representing the station location e.g., 541MER520; this format is consistent with SWAMP station code formatting.
- *Target Latitude and Longitude*: Target latitude and longitude is used to positively identify the Station Code location during sampling and reporting.

The hierarchical groupings of Program, Parent Project, and Project Codes are outlined in **Figure 2**. This hierarchy allows managers the ability to group Project Codes into logical temporal time frames like water (WY) or calendar year focused on time frames for loading data to CEDEN.

Figure 2. Relationship of Program, Parent Project, and Project Codes to Sample Table in CV RDC Database.



Project data submitted to the CV RDC must meet minimum reporting requirements for the data to be made public via CEDEN when applicable; not all data submitted to the CV RDC are transferred to CEDEN based on client needs. These specific requirements are described in the CV RDC Entry Manuals on the MLJ Environmental website.

III. MANAGEMENT INFORMATION SYSTEM (MIS)

The MIS Database is an internal data management tool to help facilitate reporting of monitoring requirements for various projects managed by MLJ staff. Depending on the needs of each individual project, elements of the MIS may or may not need to be populated. The sections below describe the general design elements and their intended use. The overall design of the database is purposefully flexible to allow the data management in the MIS to be tailored to specific client and/or project needs.

A. MONITORING SCHEDULE

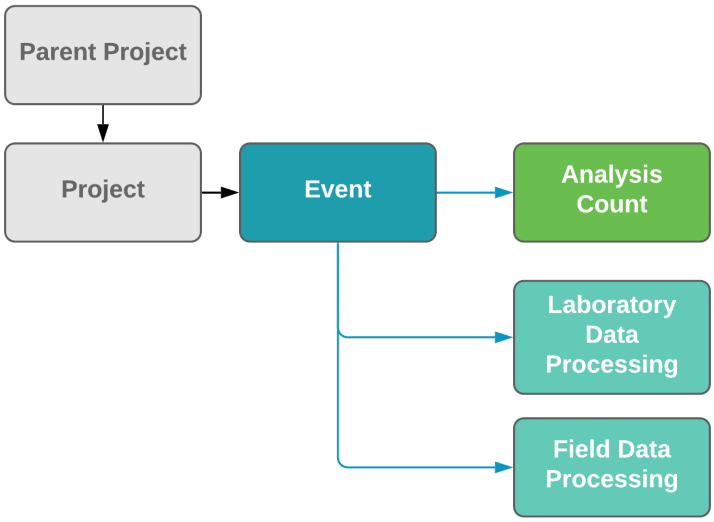
The monitoring schedule tables within the MIS Database are comprised of data necessary for developing monitoring schedules including where samples will be collected and what analytes will be measured. This monitoring schedule tables are used for the organization, planning, tracking and management of sample collection and analysis completion for each individual project.

Monitoring schedules are stored on two different levels: the sample event level and the individual analysis level (**Figure 3**).

Sample event data are associated with the Project Code defined in the MIS and the CV RDC. Each event is assigned an anticipated sampling date. Depending on the needs of the project, events can be assigned season codes and/or Event ID's which help categorize or qualify the sampling events as needed. Season codes are maintained in the MIS and are created based on project specifications (e.g., "Storm" event code for events triggered by rainfall in the area).

Individual samples are defined on the Analysis Count table and must be assigned to a sampling event. The locations (station codes) and constituents to be monitored for each sampling event are defined on this table. Sample replicates and additional quality control samples requiring additional volume are defined as individual records. Station Codes and constituents (defined by the analyte name, analytical method, matrix, fraction, and reporting units) must be comparable to lookup lists in the CV RDC. Monitoring scheduling information is captured on the individual sample level using the Monitoring Type Code on the Analysis Count table. Monitoring type codes describe how individual samples meet the requirements of the individual monitoring program requirements (e.g., an ILRP Management Plan Monitoring constituent would be coded "MPM").

Figure 3. Relationship of monitoring schedule tables in the MIS Database.



B. POPULATING THE MONITORING SCHEDULE IN THE MIS

1. Load Monitoring Schedule into the MIS Database

Data management staff work with the Project Manager to finalize and upload a complete monitoring schedule for each project. Monitoring schedules are exported directly from the MIS and can be used as part of regulatory compliance; any changes to the schedule must be updated within the database to allow for correct assessment of completion, cost estimates, and creation of field sheets and chain of custody forms.

The monitoring schedule tables (**Table 1**) include specific details necessary to achieve each project's specific data management and data usability goals; at a minimum this must include:

- Project information; comparable with the CV RDC
- Expected sample dates
- Sample event information
- Sample stations/locations; comparable with the CV RDC
- Sample type codes; comparable with the CV RDC
- Analysis information, including analyte, analytical method, matrix, fraction, and reporting units; comparable with the CV RDC
- Monitoring requirement type codes
- Sample qualifier codes

The monitoring schedule is then formatted for uploading and imported into the MIS for the tracking and reporting of completeness as monitoring occurs; this process is outlined in the SOP for Monitoring Schedule Updates and Loading into the MIS. All project, site location, and

analytical information associated with results that will be stored in the CV RDC will be maintained as comparable to the CV RDC lookup lists and codes. This ensures that data stored in the MIS Database can be linked to analytical results in the CV RDC allowing for completeness assessment and status updates during the data receipt, review and loading process.

Table 1. Monitoring schedule tables in the MIS Database.

Only the primary columns used by most projects are defined below. Ancillary fields are not included in this table; these fields can be used to manage data or further qualify project requirements where necessary.

TABLE NAME	FIELD NAME	FIELD DESCRIPTION	CV RDC COMPARABLE
Event	ParentProjectCode	High-level project definition code.	Yes
	ProjectCode	Project definition code, often specific to a designated time period in which sample collection occurs.	Yes
	ScheduledSampleDate	Anticipated date on which the sampling event will occur.	--
	SampleDate_Beginning	Actual date on which sampling began.	--
	SampleDate_End	Actual date on which sampling ended; this is the same as the beginning date if the sampling event was completed in one day.	--
	Season	Description of sampling periods, variable by to project.	--
Analysis Count	StationCode	Station at which sample is collected.	Yes
	SampleTypeCode	Code describing the type of sample to be collected (e.g., Grab, FieldBlank, etc.)	Yes
	Replicate	Sample replicate number.	Yes
	Constituent ID	Unique identifier that defines the specific constituent being sampled by analyte (or organism) name, matrix, method, fraction, and reporting units.	No[1]
	SampleCount	Number of samples associated with each record.	--
	MonitoringType	Code describing the monitoring requirements for the specific sample.	--
	SampleQualifierCode	Code describing if and by whom the sample is intended to be collected.	--
	SampleFailureCode	Code describing the reason why a sample was not collected or analyzed by the laboratory.	No
	SampleComplete	True/false field indicating whether a scheduled sample was collected; to be completed by staff during **Sample Collection Verification** outlined below.	--
	AnalysisComplete	True/false field indicating whether results were received for a collected sample; to be completed by staff during Verify **Sample Analysis** steps outlined below.	--

[1]Constituent IDs are managed separately by MLJ in both the MIS and the CV RDC. Constituent IDs in the MIS do not always directly compare to the CV RDC; however, each of the individual elements of a constituent code (analyte, matrix, method, fraction, and units) must be comparable to the CV RDC.

2. Monitoring Schedule Verification

Once the final monitoring schedule is imported into the MIS Database, the monitoring schedule is then exported and verified by the DMT, Project QA Officer, and Project Manager prior to being submitted for finalization and/or approval by a regulatory entity. This review, at a minimum, includes specific sample requirements (e.g., ensuring all dissolved metals samples are

associated with an analysis for hardness at the same site), database business rules (e.g., the correct application of data codes), and CV RDC data comparability (e.g., lookup lists). Project Managers are responsible for reviewing exported monitoring schedules for accuracy and project requirements. The Project QA Officer is responsible for reviewing this schedule to ensure all QAPP requirements (e.g., quality control sample frequency) are met. Any errors or changes found in the export are made in the database and the schedule is re-exported.

3. Analysis Count Reports for Laboratories

Finalized sample schedules are exported as reports and sent to the appropriate analytical laboratories. Laboratories can use the schedule to determine which analyses will be requested for how many samples prior to each sampling event. The Field Sampling Coordinator or Project Manager is responsible for providing these reports to laboratories when monitoring schedules are finalized in addition to coordinating with laboratory staff regarding updates to the monitoring schedule and sample bottle shipments prior to events.

C. POST-SAMPLING UPDATES TO MONITORING SCHEDULE

1. Tracking of Samples Collected

Once the sampling events scheduled in the database have occurred, MLJ staff update the MIS with specific information regarding what samples were collected during the event; this information is then compared to what was expected. These steps are discussed in the **Sample Collection Verification** section below.

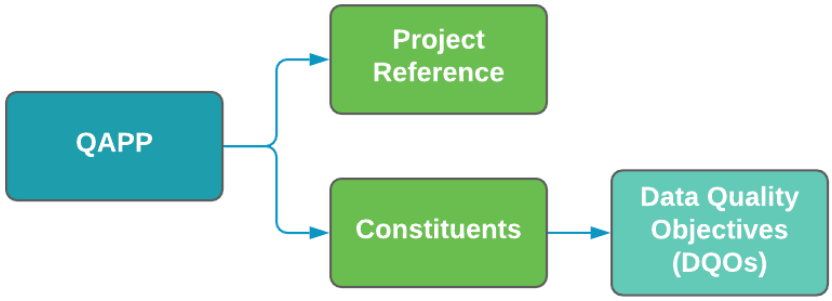
2. Informing Laboratories of Sample Details

For each event in which samples are submitted to a laboratory for analysis, specific reports (Laboratory Sample Details) are exported and sent to the analytical laboratories. These Laboratory Sample Details files provide the laboratories with the data that are required for generating CV RDC/CEDEN comparable electronic data deliverables (EDDs). The Laboratory Sample Details export process is outlined below in the **Laboratory Sample Details** section.

IV. ELECTRONIC QAPP (EQAPP) DATABASE

The electronic QAPP (eQAPP) is a relational database that stores quality assurance requirements and data quality objectives (DQOs) for each project and analyte, as defined by the project's QAPP, as shown in **Figure 4**. The eQAPP Database is the internal repository for all up-to-date quality assurance requirements for projects in which data are managed by MLJ staff. The eQAPP Database is updated when amendments to QAPPs are approved. Data exported from the eQAPP Database can be used to ensure document submittals match the most up to date quality assurance requirements stored in the database. The Project QA Officer is responsible for ensuring the eQAPP Database reflects current quality assurance requirements of each project.

Figure 4. Relationship of eQAPP tables in the MIS Database.



The MLJ DMT uses the data stored in the eQAPP Database to process EDDs received from laboratories and verify that the data reported in the EDDs meet the project requirements and associated measurement quality objects (MQOs). The eQAPP compiles quality assurance requirements in a format comparable to the CV RDC to ensure efficiency and accuracy when processing laboratory EDDs. A description of the specific fields which can be populated in the eQAPP Database are outlined in **Table 2**. Though specific requirements may vary by project, the eQAPP should include the following information to assess laboratory results:

- Original QAPP document reference and submittal information;
- Constituent information such as analyte name, matrix, method, fraction and unit, comparable with CV RDC/CEDEN;
- Preparation and digest extract methods, comparable with CV RDC/CEDEN;
- Expected MDL and RL values (not accounting for adjustments made when dilutions are performed);
- Required measurement quality objects (e.g., LCS percent recovery control limits);
- Batch completeness requirements.

Each of these elements must be defined in the database and verified by the Project QA Officer prior to the MLJ DMT processing any EDDs received for a project. Data are uploaded to and managed in the eQAPP according to the SOP, Procedures for eQAPP SQL Data Management.

Table 2. eQAPP tables in the MIS Database.

Only the primary columns used by most projects are defined below. Ancillary fields are not included in this table; these fields can be used to manage data or further qualify project requirements where necessary.

TABLE NAME	FIELD NAME	FIELD DESCRIPTION	CV RDC COMPARABLE
QAPP	QAPPCode	A code representing the QAPP under which monitoring is being conducted.	--
	QAPPName	Title of the QAPP.	--
	QAPPDescription	Narrative description of the project defined by the QAPP.	--
	QAPPStartDate	Project start date.	--
	QAPPEndDate	Project end date.	--
Project Reference	ParentProjectCode	Parent Project Code associated with data generated under the QAPP.	Yes
Constituent	Laboratory	Laboratory contracted to analyze the constituent.	No
	Constituent ID	Unique identifier that defines the specific constituent being sampled by analyte (or organism) name, matrix, method, fraction, and reporting units.	No[1]
	PrepPreservationName	Preservative or sample preparation associated with the constituent (if applicable).	Yes
	DigestExtractMethod	Digestion or extraction methods used by the laboratory (if applicable).	Yes
	MDL	Constituent detection limit.	Yes
	RL	Constituent reporting limit.	Yes
	ConstituentStatus	Indicates whether the consituent definition is active or inactive	--
	Constituent AmendmentCode	Indicates the version of the QAPP in which the constituent information was approved.	--
	Constituent StartDate	Date on which the constituent information was approved.	--
	Constituent EndDate	Date on which the constituent information was removed from the QAPP or replace by more accurate information.	--
DQOs	DQOParameter	Specific data parameter being evaluated, e.g., field duplicate RPD, matrix spike percent recovery.	--
	DQOType	Reference to the specific data quality element being assessed (e.g., “PR” for percent recovery, “RefTox” for toxicity accuracy evaluation).	--
	DQOCriterion	Assessment criteria (e.g., less than a specific value)	--
	DQOValue	The specific value or threshold used for the assessment (e.g., a maximum RPD threshold of 25)	--
	DQOCriterion Second	Any secondary criteria that should also be considered when evaluating against the primary.	--
	DQOStatus	Indicates whether the specific objective is active or inactive.	--
	DQO AmendmentCode	Indicates the version of the QAPP in which the objective was approved.	--

[1]Constituent IDs are managed separately by MLJ in both the MIS and the CV RDC. Constituent IDs in the MIS do not always directly compare to the CV RDC; however, each of the individual elements of a constituent code (analyte, matrix, method, fraction, and units) must be comparable to the CV RDC.

V. PRE- AND POST-SAMPLING DATA MANAGEMENT

For projects in which MLJ is responsible for collecting samples and submitting them to laboratories, the monitoring schedule defined in the MIS Database is used to generate sampling materials and track the status of the samples required to be monitored. The following steps can be completed for projects for which MLJ staff are responsible for all components of the monitoring completion. Each step may or may not be necessary for all projects, depending on the level of participation of MLJ staff in the sample collection process and/or specific client needs.

A. SAMPLE PREPARATION FOR MLJ MANAGED PROJECTS

The MIS can be used to prepare field sheets, sample labels and COCs. This step occurs for projects with a sampling component managed by MLJ and is not required for other projects. MLJ Sampling Staff use the MIS to prepare for an upcoming sample collection event to confirm bottle counts and additional checks of sampling materials against the MIS sampling schedule information.

1. Bottle Counts

Prior to a sampling event, MLJ field crews assess the amount of sample containers required for the event. Bottle count reports are exported using sample collection requirements stored in the MIS Database. Counts of the required containers are used to submit bottle requests to laboratories and/or order containers directly from suppliers ahead of a sampling event to ensure the required sampling materials are in house prior to the event. Bottle count reports are also used to pack coolers and allocate materials to sampling teams in preparation for sampling events. The Field Sampling Coordinator is responsible for ensuring timely requests for sample bottles from laboratories and ensuring that all supplies are obtained prior to sampling.

2. Field Sheets, Sample Labels, and COCs

Field sheets and sample bottle labels are exported directly from the database using reports designed to pull formatted information from the MIS Database. Field sheets and labels are populated with as much information as possible prior to the event to streamline tasks in the field as well as avoid erroneous sample records or analysis requests. Chain of Custody forms, which must accompany all samples once they are collected, are generated in Excel using information from the MIS sampling schedule to ensure minimal manual updates to sample event information.

Sample collection contingency plans are also generated to account for in-field changes to the sampling schedule (such as sites that may not be able to be sampled) given future monitoring events and annual analyte counts. The Field Sampling Coordinator is responsible for ensuring all sample materials are verified against the original sample schedule in the MIS Database prior to the field sampling event.

B. SAMPLE EFFORT

Samples should be collected according to the sampling SOPs included in the associated project's QAPP to ensure the collection of field data are performed in a scientifically sound and repeatable manner. Many pre- and post-sampling details not directly related to data management are detailed in the associated Sampling SOP and are not discussed in this document.

C. POST SAMPLING PROCESSES

1. Electronic Filing of Field Documentation

For projects managed by MLJ, field sheets, COCs, and sampling photos are stored electronically on a secure server which is backed up nightly. All hard copies are physically filed where they can be accessed by MLJ staff and the Project QA Officer if needed. Electronic documents must be retained for a minimum of 10 years.

2. Sampling Summary Report

For all projects in which monitoring was completed by MLJ field crews, a Sampling Summary Report is typed up after each sampling event which includes a short narrative of all stations that were sampled, sample failures, and any remarkable or anomalous events or observations made by field crews. The summary is distributed to the Project Managers and the DMT and is used to communicate the status of the sampling event including any anomalies encountered. The Field Sampling Coordinator is responsible for ensuring the Sample Summary Reports are complete and are distributed to appropriate staff.

3. Sample Collection Verification

Sample collection information is verified against the MIS schedule for each sampling event. After each sampling event, the MIS Database is updated to reflect which samples were collected based on the completed field sheets and COCs. At a minimum, the following items should be verified or updated once sampling is complete:

- **Sample Date**. The MIS Database is populated with expected sample dates when the initial monitoring schedule is loaded. These dates need to be verified or updated to the day or range of days on which the sampling event occurred.
- **Sample Complete**. Each sample that was scheduled should be marked as true/false for sample completed. All samples and analytes planned to be collected must be accounted for in the monitoring schedule in the MIS Database (**Table 1**). If a scheduled sample was not collected, the record in the database should be flagged with the correct failure code to qualify why the sample is missing. The acceptable failure codes currently listed in the database are provided in **Table 3**.

Table 3. Acceptable sample failure codes to be used in the MIS database.

Where possible, failure codes are similar to those defined in CEDEN; however, not all failure codes stored in the MIS Database are CEDEN comparable, some have been added for internal tracking.

SAMPLE FAILURE CODE	SAMPLE FAILURE	DESCRIPTION
BRK	Sample bottle broken	Sample bottle broken.
CMIS	Collection Missed	Sample failed to be collected due to oversite on COC/fieldsheet.
DIS	Discontinued	Sample was originally scheduled to be sample but was then discontinued. No sample was collected because it was no longer required.
DRY	Dry	Dry (No water)
FLD	Flooded	Flooded
HAB	Hard Bottom	Hard Bottom (no sediment)
INF	Instrument Failure	Instrument failure
ISP	Isolated Pool	Isolated pool not connected to moving water source, no flow.
LMIS	Laboratory Missed. Did Not Analyze	Sample was not analyzed by the lab due to lab error.
None	None	No failure, sample was collected.
TEMPLAB	Sample stored at improper temperature by Lab.	Sample stored at improper temperature by Lab. Not storing or utilizing results.
TOS	Too Shallow	Too shallow to collect water samples.

4. QC Sample Verification and Assessment

If there is a situation where a site is scheduled for QC sample collection and the samples could not be collected, the QC samples will need to be collected at a different site. The determination of the back-up site at which the QC samples are collected is usually made in the field based on sample collection contingency plans established prior to sampling. Wherever this occurs, the sample schedule in the MIS must be updated after the sampling event to include the field QC samples that were actually collected. In addition, field QC sample frequency requirements must be reassessed after every sampling event to ensure any changes in the field do not reduce the total amount of QC samples required for the project. The QC frequency percentages are recalculated following each event to ensure the minimum requirements for each analyte are still met. Any field QC that could not be collected during the event must be rescheduled for future events to ensure that QC frequency requirements are met. The Field Sampling Coordinator should notify the Project QA Officer if there are no future events in which the analyte(s) in question are scheduled and the QC frequency requirements required by the QAPP will not be met.

D. EXPECTED SAMPLE RESULTS TRACKING

The sample tracking component of the MIS Database is used to ensure that requirements are met for each sample from the beginning of the process (sample collection) to end (finalized results loaded in the CV RDC). Once a sample has been collected and verified against the

monitoring schedule, a record must be created to track all future expected reporting deliverables. Reporting deliverables will be project specific and may include preliminary laboratory results, laboratory reports, EDDs, and laboratory invoices.

Field result process and deliverables are tracked on the Field Data Processing table in the MIS Database (**Figure 3**). A record must be created on this table to track each of the steps outlined below for the **Field Data Processing** requirements. The specific fields on this table are outlined in **Table 4**.

Table 4. Field data processing steps tracked in the MIS Database.

TABLE NAME	FIELD NAME	FIELD DESCRIPTION	REFERENCE
Field Data Processing	FieldEntryCompleteDate	Date on which field data entry was completed.	**Field Data Entry**
	FieldEntryPerformedBy	Staff who completed field data entry	
	FieldVerificationCompleteDate	Date on which field data verification was completed.	**Field Result Quality Assurance**
	FieldVerificationPerformedBy	Staff who completed field data verification.	
	FieldEntryVerificationComments	Details regarding field data verification.	
	SampleDetailsSentDate	Date on which the sample details file was sent to the laboratory.	**Laboratory Sample Details**
	SampleDetailsSentBy	Staff who sent the sample details file to the laboratory.	
	SampleDetailComments	Details regarding sample details communications with laboratories.	
	FieldExceedanceReportRequired	Indication of additional project action requirements triggered by the field results.	--

In the Laboratory Data Processing table (**Figure 3**), a separate record needs to be created for each laboratory and report type combination that is expected to be received given what was collected and submitted for analysis. These records will be used for tracking expected reports from laboratories and paying laboratory invoices once all deliverables have been received, as outlined in **Table 5**.

The sample completion counts and expected report records are used by MLJ DMT staff in charge of receiving laboratory results to track timely receipt of deliverables from laboratories and to verify the completeness of the results received. Accurate sample counts are crucial to the analytical data verification steps outlined below (see **Laboratory Data Processing**). Sample collection verification activities are overseen by the Project QA Officer.

Table 5. Laboratory data processing steps tracked in the MIS Database.

TABLE NAME	FIELD NAME	FIELD DESCRIPTION	REFERENCE
Laboratory Data Processing	Laboratory	Analyzing laboratory form which a report is expected.	--
	ReportType	Description of expected report.	--
	ReportNumber	Report identifier provided by the laboratory.	--
	PrelimLabReportReceivedDate	Date on which preliminary results were received by the laboratory.	**Receipt and Filing of Laboratory Results**
	LabReportReceivedDate	Date on which the PDF report was received by the laboratory.	
	EDDReceivedDate	Date on which electronic data were received by the laboratory.	
	LabReportEDDReceivedComments	Details regarding the receipt of laboratory deliverables.	
	LabReportReviewedDate	Date on which the PDF report was reviewed by MLJ staff.	**Initial Laboratory PDF Review**
	LabReportReviewedBy	Staff who completed the report review.	
	LabReportReviewComments	Details regarding the review of the report.	
	LabExceedanceReportRequired	Indication of additional project action requirements triggered by the results.	
	EDDReviewedDate	Date on which the electronic data were reviewed by MLJ DMT.	**Processing of Chemistry EDDs, Processing of Toxicity EDDs, Processing of Tissue EDDs**
	EDDReviewedBy	Staff who completed the electronic data review.	
	EDDDoubleCheck	Staff who verified the electronic data processing.	**Loading Laboratory Results into CV RDC Database**
	EDDReadyToLoad	A true/false field indicating if an EDD is in the queue for loading to the CV RDC.	
	EDDLoadedDate	Date on which a processed EDD was loaded to the CV RDC.	
	EDDLoadedBy	Staff who loaded the data to the CV RDC.	
	EDDComments	Details regarding the processing and loading of the EDD.	
	InvoiceNumber	Identifier of the invoice for the analyses completed and data received.	--
	InvoiceDate	Date on which the invoice was received.	
	InvoiceComments	Details regarding the invoicing process.	

VI. FIELD DATA PROCESSING

A. FIELD DATA ENTRY

Field data must be entered into the CV RDC database after each sampling event is complete using information recorded on the field sheets. There are two options for field data entry into the CV RDC: 1) direct field data entry using the Environmental Data Entry and Reporting System (eDERS) hosted by MLML, or 2) upload of field results using the CEDEN Field Template.

1. Option 1 – Field Data Entry via eDERS

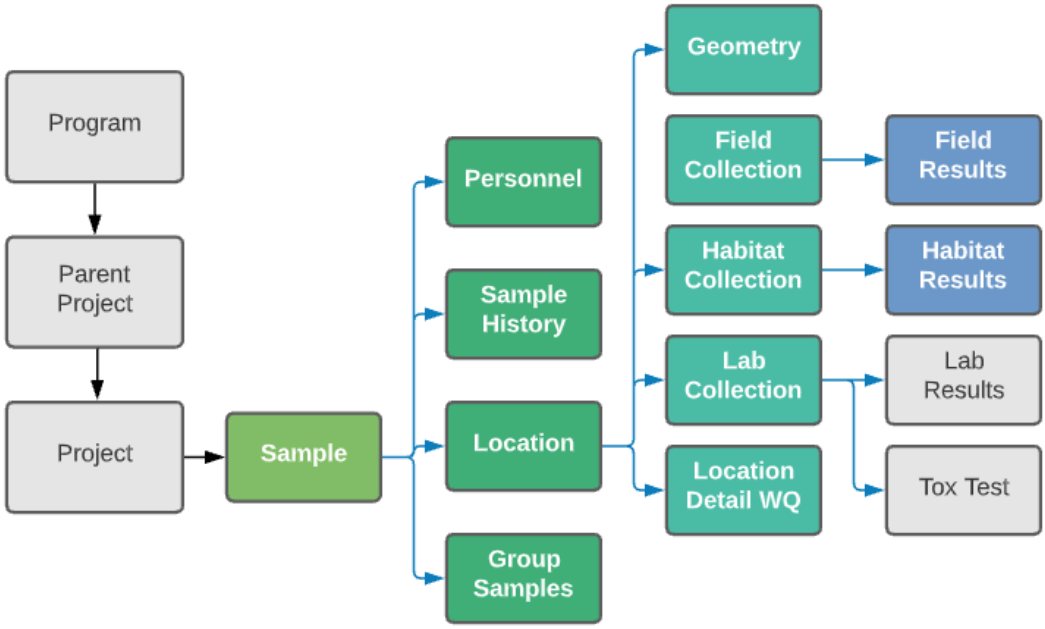
Data are entered directly into the CV RDC using the eDERS online webforms. Field data are entered according to the Field Data Entry SOP. The eDERS field data entry forms were developed based on SWAMP field sheets and include drop down lists from the valid lookup list tables to ensure CEDEN comparability.

2. Option 2 – Field Data Entry via CEDEN Field Template

If data are formatted in the Field Template, then MLJ DMT staff can load them directly into the CV RDC as a single file, rather than entering results by hand. Data are loaded using a series of queries to add the results to the CV RDC relational database design. Automated checks are performed on the data during the loading process to ensure that results are unique, assigned to the correct project and site information, formatted correctly, contain the correct valid values, and that all required fields are populated. Result table counts are tracked prior to loading and compared to counts after loading to ensure all intended results were uploaded. After the Field Template is loaded, specific verification steps are performed to ensure the correct results have been added into the CV RDC database.

The conceptual relational table design in the CV RDC storing field data is shown in **Figure 5;** the CV RDC design matches the design in CEDEN to ensure comparability and ability to transfer data directly to CEDEN.

Figure 5. Sample through Field and Habitat Result tables the CV RDC Database.



The field data that are usually entered into the CV RDC by MLJ staff are listed in **Table 6**. Fields listed as "required" in **Table 6** must be entered into the database for each sample collected.

Table 6. Field and habitat result tables in the CV RDC.

Only primary fields are included; ancillary fields for each table referenced are not included but can be found in CV RDC documentation available online. All columns described below are preferred to be populated to best describe the project data; however, not all columns are required (are nullable) in the CV RDC database. Fields required to be populated are indicated with a "Yes" in the CV RDC Required column. In some cases, default values may be added by MLJ staff when information is not available from the data submitter.

TABLE NAME	FIELD NAME	FIELD DESCRIPTION	CV RDC REQUIRED
Sample	EventCode	Represents the primary reason for the sampling event at a particular station and date, e.g., water quality, tissue or bioassessment.	Yes
	ProjectCode	References the project that originated the sample.	Yes
	StationCode	A 9-digit assigned code that uniquely identifies the monitoring location within the CV RDC database.	Yes
	SampleDate	The date the sample was collected in the field, expressed as dd/mmm/yyyy.	Yes
	AgencyCode	The acronym for the agency that collected/created the sample.	Yes

TABLE NAME	FIELD NAME	FIELD DESCRIPTION	CV RDC REQUIRED
	ProtocolCode	A code representing the sampling protocols and methods used during the sampling event.	Yes
	SampleComments	The comments field should be used for any notes or comments specifically related to the sample collection.	
Sample History	SamplePurposeCode	A code representing the reason samples were collected from a specific station on a specific date to collect (e.g., habitat, water chemistry).	Yes
	PurposeFailureName	A code used to identify if there were any issues with collecting any of the intended samples/information at a site, (e.g., dry site).	Yes
Personnel	PersonnelCode	A code representing the personnel collecting the sample.	Yes
Group Sample	Group Code	Allows programs to group samples together to meet individual program needs, such as by Season.	Yes
Geometry	Latitude	Latitude from which sample was taken in decimal degrees with 5 decimal places.	Yes
	Longitude	Longitude from which sample was taken in decimal degrees with 5 decimal places.	Yes
	GPSDevice	A code identifying the GPS device used to collect the GPS measurements.	Yes
	Datum	The Datum field records the datum that was used on the GPSDevice to record the GPS measurements.	
	GPSAccuracy	The accuracy of the GPS device used to collect the GPS measurements.	
Location Detail	OccupationMethod	Method of station occupation for sample collection (e.g. "Walk In", "From Bridge", or report research vessel name).	
	Starting Bank	Bank where distances are measured from; left or right bank (when looking downstream).	
	Stream Width	Stream Width at the station where sample was taken.	
	Unit Stream Width	Units in which the stream width is measured.	

TABLE NAME	FIELD NAME	FIELD DESCRIPTION	CV RDC REQUIRED
	Station Water Depth	The average of the water depth measurements when taking discharge.	
	Unit Station Water Depth	Unit in which Station Water Depth was measured.	
	Hydromodification	Any hydromodification at sample site (e.g., Bridge, ConcreteChannel, Pipes).	
	Hydromodification Loc	Location of hydromodification relative to sample – upstream, downstream, not applicable, or not recorded	
	Location Detail WQ Comments	The comments field should be used for any notes or comments specifically related to location details. Put additional hydromodifications here.	
Lab Collection	Collection Method	The general method of collection (e.g., "Water_Grab", "Sed_Grab", "Autosampler24h")	Yes
	Sample Type	The type of sample collected or analyzed (e.g., "Grab", "Fieldblank", "LCS")	Yes
	Collection Time	The time when the first sample was collected at that site in the field, expressed as hh:mm. (24 hour clock).	Yes
	Replicate	A number that identifies replicates created in the field.	Yes
	Collection Device	The specific device used to collect samples.	Yes
	Position in Water Column	Position in water column where sample was taken.	
	Collection Depth	The depth at which the sample was collected.	Yes
	Unit Collection Depth	The units associated with the above "CollectionDepth" value.	Yes
Habitat Collection	CollectionMethodCode	A code referring to the general method of collection. Default for habitat is "Not Applicable".	Yes
	Collection Time	The time when the first sample was collected at that site in the field, expressed as hh:mm. (24 hour clock).	Yes
Habitat Result	Constituent	A combination of the analyte, matrix, method, fraction, and unit being collected.	Yes
	Variable Result	Non numerical or qualitative result collected as field observations.	
	ResQualCode	A code that qualifies the result for the sample, if necessary. The Default value is "=" for Habitat.	Yes

TABLE NAME	FIELD NAME	FIELD DESCRIPTION	CV RDC REQUIRED
	QACode	A code that describes any special conditions, situations or outliers that occurred during or prior to the observation to achieve the result.	Yes
	Collection Device	The specific device used to collect sample.	Yes
	Habitat Result Comments	The comments field should be used for any notes or comments specifically related to the habitat result. Put additional variable results here if needed.	
Field Collection	Collection Method	Refers to the general method of collection. Default value is "Field".	Yes
	Collection Time	The time when the first sample was collected at that site in the field, expressed as hh:mm. (24 hour clock).	Yes
	Collection Depth	The depth at which the sample was collected.	Yes
	Unit Collection Depth	The units associated with the "CollectionDepth" value. The default values should be "m" (meters) for water samples or "cm" (centimeters) for sediment samples.	Yes
	Position Water Column	The position in the water column where the sample was taken.	
Field Results	Constituent	A combination of the analyte, matrix, method, fraction, and unit being collected.	Yes
	Result	The result of the field measurement.	
	ResQualCode	Qualifies the result for the sample, if necessary. The Default value is "=".	Yes
	QACode	A code that describes any special conditions, situations or outliers that occurred during or prior to the observation to achieve the result.	Yes
	Collection Device	A code that refers to the refers to the specific device used in the collection of the sample.	Yes
	Calibration Date	Date on which the field collection device was calibrated.	Yes
	Field Result Comments	The comments field should be used for any notes or comments specifically related to the field result. If any failures or issues occurred put explanation here.	

For all samples collected by MLJ sampling staff, a combination of qualitative habitat results and quantitative field measurements are taken whenever a site is visited.

The habitat observations that are usually collected by MLJ sampling staff and entered into the CV RDC include:

- Color (specific to either the sediment or water being collected),
- Composition (specific to sediment),
- Dominant substrate,
- Observed flow,
- Odor (of the overall site and the water and/or sediment)
- Other presence,
- Precipitation,
- Precipitation in the last 24 hours,
- Sky code (clear, cloudy, etc.),
- Wadeability of the waterbody,
- Water clarity,
- Wind direction,
- Wind speed.

In addition, MLJ staff take photos of site conditions when visiting a sample location; codes referencing the photo documentation taken by sampling staff are stored in the CV RDC database with habitat parameters.

Quantitative measurements are taken in the field by MLJ staff whenever site conditions allow. Field measurements are taken using multiparameter meters and flow meters according to the Sample Collection SOPs followed by sampling staff. Specific field measurements may vary according to individual project requirements; however, in most cases MLJ staff collect the following measurements that are recorded in the CV RDC during field data entry:

- Air temperature in °C,
- Discharge in cfs,
- Dissolved oxygen in mg/L,
- Specific conductivity in uS/cm,
- pH,
- Water temperature in °C

Once complete, data entry should be tracked by adding the data entry staff name (formatted as last name and first initial) and date of entry in the Field Data Processing table in the MIS Database (**Table 4**).

B. FIELD RESULT QUALITY ASSURANCE

Once field data are entered into the CV RDC database, all electronic field data should be double checked against the original field collection records. Depending on the project this may be all records.

For field results entered directly into eDERs, the final field data are exported and copied into an Excel workbook to review for accuracy using the following steps.

1. Export Field Data from eDERS

Each of the following items should be exported into a single Excel sheet for the sampling event using the queries provided:

- Sample, Personnel, Group, Purpose, Location, Geometry, and Location Detail information
- Field Results
- Habitat Results
- Lab Collection

2. Compare the Electronic Field Data to the Field Sheets

Each Excel spreadsheet is verified against the field sheets from the sampling event. Data entry QC is completed by a staff member who did not complete the data entry. The Excel files and field sheets should be reviewed for both completeness and accuracy of entry. All sample failures (such as dry sites or sites to which sampling crews could not gain access) should be noted on the field sheets and recorded in the CV RDC and MIS Databases to account for any deviations from the planned monitoring schedule.

Once complete, field result verification should be tracked by adding the data entry staff name (formatted as last name and first initial) and date of verification in the Field Data Processing table in the MIS Database (**Table 4**).

Once field results are entered into the database and verification is complete, MLJ staff will compare the collection information to field QC requirements outlined in the QAPP to ensure that all required QC samples were collected (see **QC Sample Verification and Assessment**). Failure to meet minimum field QC sample requirements during a sampling event must be reported to the Project QA Officer and Project Manager.

C. LABORATORY SAMPLE DETAILS

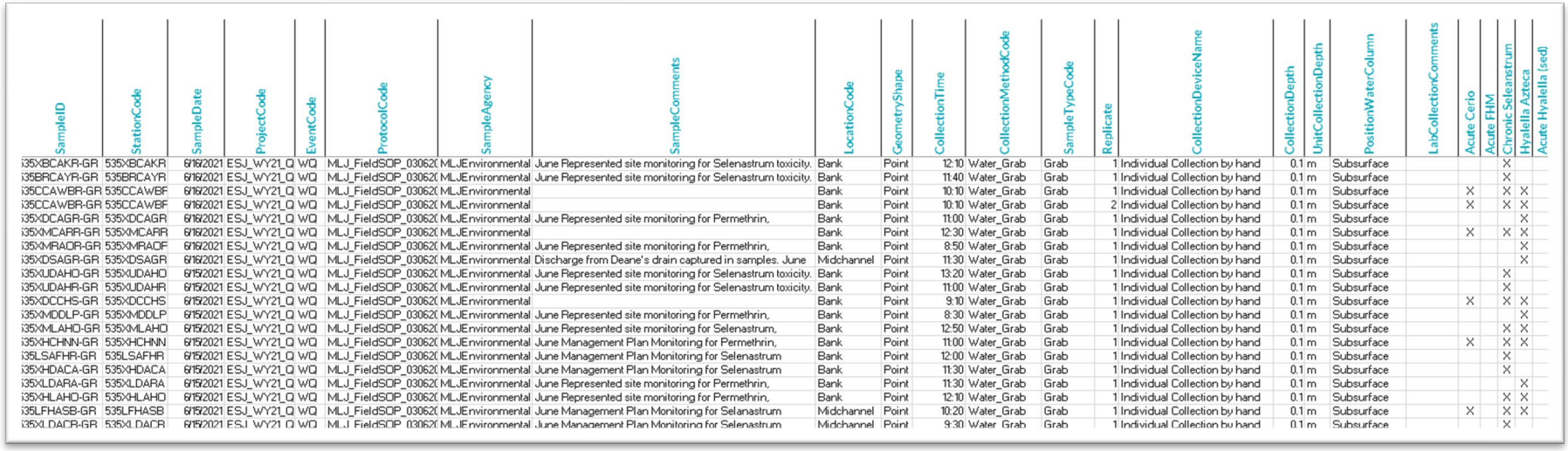
Once field data are entered into the CV RDC, the laboratory sample detail information is exported and submitted to the laboratories in an Excel file referred to as Sample Details. The laboratories use the Sample Details file to populate the sample collection information required in the CEDEN comparable EDD. The Sample Details includes the CEDEN analyte names of the constituents associated with samples submitted for analysis. Sample Details should be sent to the laboratory as soon as possible after the event is completed and field data are verified. The following information should be queried from the CV RDC to create Sample Details for each sampling event:

- Sample ID (generally a combination of the Station Code and the sample type information)
- Station Code
- Sample Date
- Project Code
- Event Code
- Protocol Code
- Agency Code
- Sample Comments

- Location Code
- Geometry Shape
- Collection Time
- Collection Method Code
- Sample Type Code
- Replicate
- Collection Device Name
- Collection Depth
- Unit Collection Depth
- Position Water Column
- Lab Collection Comments

Once submitted to the laboratory, the sample details should be tracked by adding the staff name (formatted as last name and first initial) and date on which the file was sent in the Field Data Processing table in the MIS Database (**Table 4**). An example of a final laboratory Sample Details report is shown in **Figure 6**.

Figure 6. Example sample details sent to a laboratory to assist in completing and formatting EDDs.



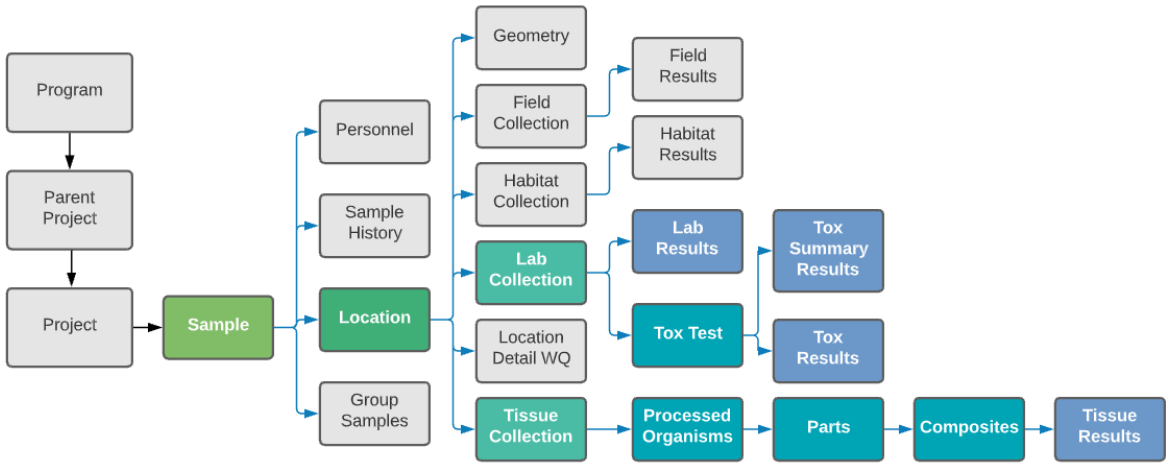
SampleID	StationCode	SampleDate	ProjectCode	EventCode	ProtocolCode	SampleAgency	SampleComments	LocationCode	GeometryShape	CollectionTime	CollectionMethodCode	SampleTypeCode	Replicate	CollectionDeviceName	CollectionDepth	UnitCollectionDepth	PositionWaterColumn	LabCollectionComments	Acute Cerio	Acute FHM	Chronic Selenastrum	Hyalella Azteca	Acute Hyalella (sed)
535XBCAKR-GR	535XBCAKR	6/16/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Selenastrum toxicity.	Bank	Point	12:10	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X		
535BRCAYR-GR	535BRCAYR	6/16/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Selenastrum toxicity.	Bank	Point	11:40	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X		
535CCAWBR-GR	535CCAWBF	6/16/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental		Bank	Point	10:10	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface		X		X	X	
535CCAWBR-GR	535CCAWBF	6/16/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental		Bank	Point	10:10	Water_Grab	Grab	2	Individual Collection by hand	0.1	m	Subsurface		X		X	X	
535XDCAGR-GR	535XDCAGR	6/16/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Permethrin,	Bank	Point	11:00	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface					X	
535XMCARR-GR	535XMCARR	6/16/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental		Bank	Point	12:30	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface		X		X	X	
535XMRAOR-GR	535XMRAOF	6/16/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Permethrin,	Bank	Point	8:50	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface					X	
535XDSAGR-GR	535XDSAGR	6/16/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	Discharge from Deane's drain captured in samples. June	Midchannel	Point	11:30	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface					X	
535XUDAHO-GR	535XUDAHO	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Selenastrum toxicity.	Bank	Point	13:20	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X		
535XUDAHR-GR	535XUDAHR	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Selenastrum toxicity.	Bank	Point	11:00	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X		
535XDCCHS-GR	535XDCCHS	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental		Bank	Point	9:10	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface		X		X	X	
535XMDDLP-GR	535XMDDLP	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Permethrin,	Bank	Point	8:30	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface					X	
535XMLAHO-GR	535XMLAHO	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Selenastrum,	Bank	Point	12:50	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X	X	
535XHCHNN-GR	535XHCHNN	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Management Plan Monitoring for Permethrin,	Bank	Point	11:00	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface		X		X	X	
535LSAFHR-GR	535LSAFHR	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Management Plan Monitoring for Selenastrum	Bank	Point	12:00	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X		
535XHDACA-GR	535XHDACA	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Management Plan Monitoring for Selenastrum	Bank	Point	11:30	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X		
535XLDARA-GR	535XLDARA	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Permethrin,	Bank	Point	11:30	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface					X	
535XHLAHO-GR	535XHLAHO	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Represented site monitoring for Permethrin,	Bank	Point	12:10	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X	X	
535LFHASB-GR	535LFHASB	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Management Plan Monitoring for Selanastrum	Midchannel	Point	10:20	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface		X		X	X	
535XLDACR-GR	535XLDACR	6/15/2021	ESJ_WY21_Q	WQ	MLJ_FieldSOP_03062(	MLJEnvironmental	June Management Plan Monitoring for Selenastrum	Midchannel	Point	9:30	Water_Grab	Grab	1	Individual Collection by hand	0.1	m	Subsurface				X		

VII. LABORATORY DATA PROCESSING

A. LABORATORY DATA TABLES AND STRUCTURE

Laboratory data are submitted to the MLJ DMT using a CEDEN comparable EDD template. Data are reviewed and loaded into the CV RDC Database through data loading tools that are maintained by the MLJ DMT staff (**Figure 1**). The relational table design in which laboratory data are stored in the CV RDC Database is shown in **Figure 7**.

Figure 7. Sample through Laboratory and Toxicity Result tables within the CV RDC database.



B. MINMUM REQUIREMENTS FOR DATA FORMATTING AND SUBMISSION

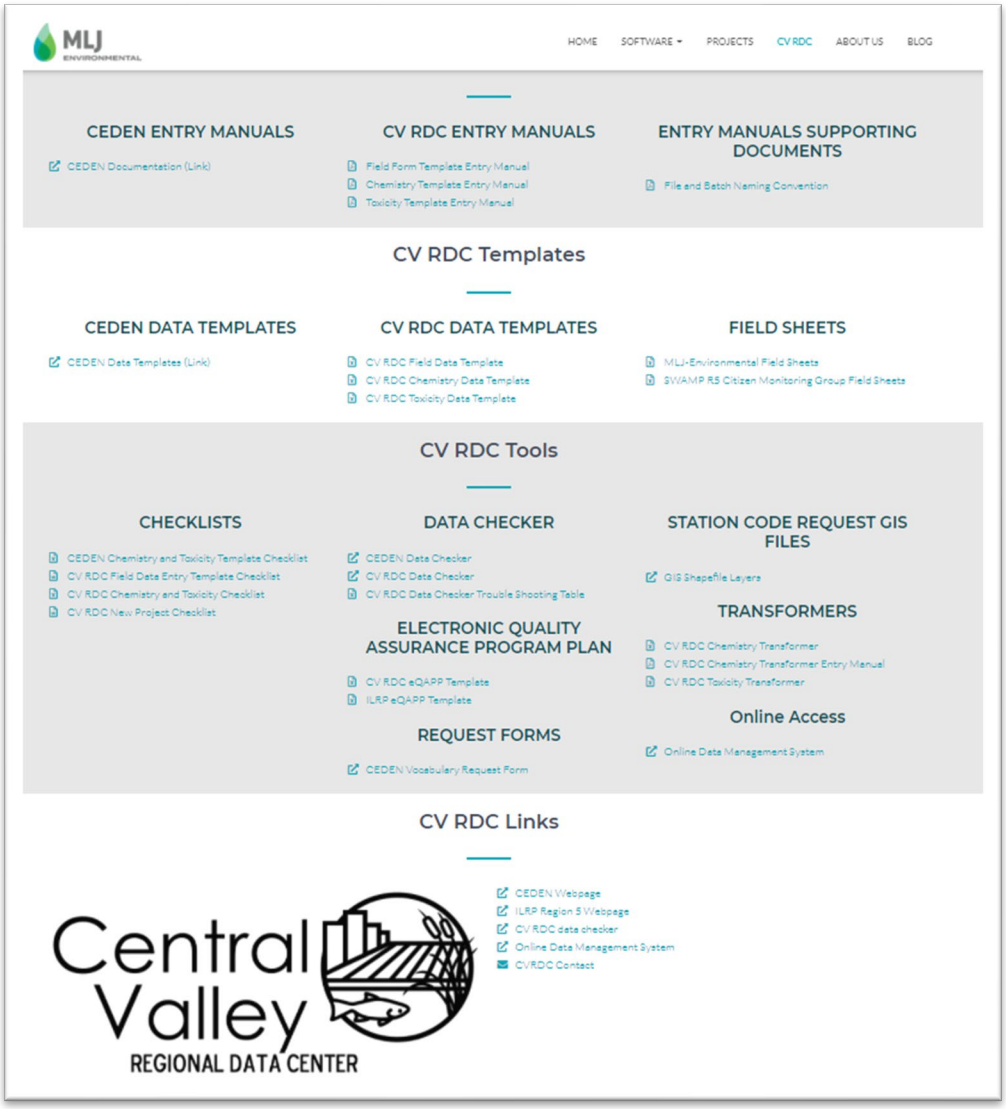
Reporting laboratories follow the CV RDC data submission steps can be found on the MLJ website. MLJ DMT staff are available to assist with questions about the processes outlined on the website. Data submission steps are as follows:

- Step 1: Review of required data elements,
- Step 2: Determine comparability and register project (see **Project Definition**),
- Step 3: Entry into appropriate templates,
- Step 4: Verification that data are correct and comparable,
- Step 5; Submission of data to CV RDC,
- Step 6: Coordination (if appropriate) whether data should be exported to CEDEN.

MLJ works in partnership with laboratories to assist with data reporting. MLJ staff generate **Laboratory Sample Details** for the laboratories to ensure the correct sample collection information is included in the EDD. MLJ ensures all necessary reporting templates and documentation are available online, including online data checkers to facilitate data submission

(**Figure 8**). These checkers allow the submitting agencies to double check the EDDs they have generated against common CV RDC/CEDEN business rules and lookup list values.

Figure 8. Online resources for data submissions available on the MLJ website.



C. RECEIPT AND FILING OF LABORATORY RESULTS

Laboratory results are typically received in two formats: a PDF report in the laboratory's standard output format and an EDD in CV RDC/CEDEN template formats. Once received, both the PDF and the original EDD are electronically filed on secure servers and marked as received by MLJ DMT staff in the Laboratory Data Processing table in the MIS Database (**Table 5**). All documents must be retained for a minimum of 10 years.

Laboratory reports and EDD files are received by email from the individual project and/or data managers for each laboratory. Results should be received according to the schedule as outlined

in individual laboratory contracts and the QAPP. Though turnaround times may vary, laboratories are generally expected to provide the PDF report within 30 days of sample submission and the EDD within 45 days; preliminary results from toxicity testing are generally expected within two weeks. Occasionally, unforeseen delays can occur for receiving laboratory information (such as re-analyses due to QC failure). When laboratory deliverables are not received within the specified timeframe, MLJ staff will follow up with laboratory staff and request an estimated date for the deliverable. Deliverables that are excessively late must be discussed with the Project QA Officer.

Laboratory deliverables must be entered in the MIS Database with a receipt date that reflects the business day on which the laboratory submitted them to MLJ. Any deliverables received before 4 PM on a business day should be recorded with that received date; any deliverables received on a weekend, holiday, or after 4 PM on a business day should be marked as received on the next business day.

D. INITIAL LABORATORY PDF REVIEW

Laboratory results are usually provided in the PDF report prior to receiving the EDDs. Results received in the PDF should be reviewed for completeness and high-level QC concerns immediately upon receiving the report from the laboratory. This initial review allows the opportunity to resolve questions or concerns with the laboratory before the results are provided in the EDD. Furthermore, for some projects, results exceeding thresholds or trigger limits are assessed and reported within a specific time frame according to their program requirements. Trigger limit assessments are completed during this review to ensure program deadlines are met.

Review of the laboratory report is only an initial review; the same checks are repeated during the more in-depth EDD review outlined below. At a minimum, the initial checks of the PDF report should include:

- **Initial sample completeness.** Ensure all analytes requested are reported.
- **Initial blank sample assessment.** Ensure there are no detections above the allowable limit in laboratory and field blanks.
- **Initial positive control sample assessment.** Check the recoveries reported for MS and LCS samples. For projects where the QAPP states that all MS samples with zero percent recovery are reanalyzed, MLJ DMT staff will ensure reanalysis did occur. Reports with multiple positive control failures should be reviewed by the Project QA Officer.
- **Case narrative review.** Any anomalous or concerning issues identified in the report case narrative should be communicated to and reviewed by the QA Officer.

Any reporting discrepancies should be communicated back to the laboratory for clarification and/or a revised report. Significant QC issues noted by MLJ DMT staff during the initial review should be further reviewed by the Project QA Officer to ensure the project requirements are met and determine whether corrective actions need to be taken by the laboratory or MLJ staff. Communications with the laboratory or the QA Officer should occur as soon as possible to ensure project timeline requirements (such as trigger limit exceedance reporting deadlines) are met.

E. PROCESSING OF CHEMISTRY EDDS

Prior to loading an EDD into the CV RDC database, each EDD is reviewed following a checklist that has been customized for the specific reporting laboratory, data type, and project (when applicable). The fundamental checklist items are described below; the detailed checklist used to process chemistry EDDs is provided in **Attachment A**.

EDD reviews require three items: the EDD, the accompanying PDF laboratory report, and eQAPP information.

1. Verify Sample Analysis

All laboratory results should be verified against the sample collection records and COCs upon receipt from the laboratory. Each record in the original monitoring schedule in the MIS that was marked as sampled should now be marked as completed for the analysis. Any missing or mis-reported analyses must be communicated back to the laboratory. Expected analyses that were not completed must be marked as incomplete and qualified with the correct Sample Failure Code on the Analysis Count table in the MIS Database (**Table 3**).

The Project QA Officer is responsible for overseeing laboratory result verification and ensuring that revised reports and data deliverables are received, as necessary. The Project QA Officer may delegate some of this work including communication with the laboratory, follow ups regarding revised report and tracking of QC anomalies.

Any re-analyses should be reviewed by the Project QA Officer for proper reporting procedures. The Project QA Officer or their delegate should communicate with the laboratory to decide which data are acceptable and ensure they are properly flagged and qualified. Only one set of results for any analysis will be loaded into the CV RDC Database (reanalysis results can be referenced in result comments).

2. Remove Extra Non-Project QC Data

Analytical batches processed in the laboratory often contain samples from multiple projects; when laboratories provide all QC results associated with a batch, they may include matrix spike results performed on samples from a different project. At the discretion of the QA Officer, MLJ DMT staff will remove any extra non-project or non-direct data that is not needed to qualify results. Occasionally non-project data are needed to fulfill batch QC requirements; when this occurs, data are assessed against the same QAPP requirements used for project-generated samples (see **Verify Laboratory Data Quality Control**).

3. Verify Results

Electronic data deliverables should be verified against the PDF reports to ensure reporting consistency between report formats. When laboratories generate EDDs directly from their Laboratory Information Management System (LIMS), a minimum of 10% of the data must be verified against the PDF report. When EDDs are hand entered by the laboratory, 100% of the results provided must be checked against the report.

If discrepancies are found during the 10% data verification, additional verification is needed to ensure the laboratory export is correct and matches the PDF laboratory report. Issues are communicated back to the laboratory and, if needed, a new export will be requested.

4. Verify Processing and Analysis Information

All analytical sample processing and analysis information should be verified against the project-specific requirements outlined in the eQAPP and against the business rules of the CV RDC (e.g., correct formatting of the LabBatch identifier). Any discrepancies between the processing and analysis information and the expected requirements in the project eQAPP should be communicated back to the contract laboratory and the report amended if applicable. At a minimum, results will be checked for:

- Expected LabBatch formatting utilizing CV RDC batch naming conventions.
- Expected batch grouping – ensure that the LabBatch is grouped by method.
- Expected batch completion times – ensure the analysis dates and digest/extract dates (where applicable) in a batch are within 24 hours of each other.
- Expected analyte/calculation reporting.
- Expected preparation or digest methods.
- Expected minimum detection limits (MDLs) and reporting limits (RLs) - ensure detection and reporting limits match those specified in the eQAPP. Diluted samples are reported with elevated detection and reporting limits, so only results with a dilution factor of 1 would be expected to match the QAPP.
- Expected reporting units.

5. Verify Formatting

Fields that are not controlled by valid values (e.g., comment fields) need to be reviewed to ensure consistency and usability. According to CV RDC business rules and the original SWAMP formatting, the Lab Result Comments field is used to capture percent recovery (PR) and relative percent difference (RPD) values for accuracy and precision control samples. The laboratory result comment field should be formatted as follows for all MS, LCS, laboratory duplicate, or field duplicate samples:

1. Indicate PR or RPD, followed by the calculated value: PR XX or RPD XX. (e.g, PR 99)
    - When in combination, separate the two values with a comma: PR XX, RPD XX (e.g. PR 99, RPD 5).
    - Some programs indicate FD RPD XX for field duplicates.

Any non-detect results should be blank and coded “ND” for the result qualifier code. Results below the MDL are considered non-detect.

6. Calculating Field Duplicate Precision

Field duplicate RPD (or applicable precision evaluation) calculations are not normally provided by the laboratory; these values must be calculated according to requirements outlined in the QAPP and added to the Lab Result Comments of the EDD for evaluating field duplicate acceptability.

When a field duplicate or parent sample result is non-detect the RPD cannot be calculated and the RPD is indicated as "RPD NA" in the Lab Result Comments field.

7. Verify Laboratory Data Quality Control

All laboratory analysis results will be verified against the current MQOs stored in the eQAPP Database. Any data that do not meet the project acceptability criteria must be flagged with an approved quality assurance flag defined in the CV RDC/CEDEN QACode LookUp lists. Common quality assurance flags are listed in **Table 7** as well as business rules for how the codes are applied for most projects in which data are processed by MLJ staff. All acceptable, unflagged data are assigned a QACode of None to indicate there were no anomalies for which a QACode is required. No records with an unpopulated QACode field can be loaded to the database.

If necessary, MLJ DMT staff will update QACodes applied by the laboratory to match the project QA requirements. Any updates will be highlighted and provided to the laboratory to ensure the correct QACode is applied in future EDDs.

Any quality assurance concerns that require an additional code not yet approved for use in a specific project must be reviewed by the project QA Officer. All approved codes are reviewed for CV RDC/CEDEN comparability and for consistency of QA failure classification by the Project QA Officer. Qualified data are still considered useable as multiple factors are considered when determining usability; refer to specific QAPPs for information regarding the determination of useable data.

At a minimum, the following QC checks must be performed prior to loading analytical data into the database:

- **Hold time compliance.** Samples are evaluated to ensure they were performed within the designated hold time outlined within the eQAPP.
- **QC sample frequency evaluation.** Depending on the specific requirements outlined in the QAPP, most batches should be analyzed with the following QC samples:
  - Laboratory blank,
  - Laboratory control spike (LCS),
  - Matrix spike (MS), and
  - Laboratory duplicate.

  When sample frequency requirements are not met, the LabSubmissionCode is updated to "QI" to indicate incomplete QC; otherwise, the LabSubmissionCode is populated according to the **LabBatch Information Updates** conventions. A Lab Batch Comment is always required to indicate why batch QC frequency was not met.
- **Field QC sample evaluation.** All applicable field QC should be evaluated according to the requirements in the eQAPP. This usually includes (but is not limited to):
  - Field blank detections – any field blank detections should be below the acceptable limit outlined in the eQAPP.
  - Field duplicate acceptability – field duplicate RPDs must be below the acceptable limit outlined in the eQAPP.

- **Laboratory QC sample evaluation.** All applicable Laboratory QC should be evaluated according to the requirements in the eQAPP. This usually includes (but is not limited to):
  - Laboratory blank detections – any laboratory blank detections should be below the acceptable limit outlined in the eQAPP.
  - Laboratory control spike (LCS) recoveries – PR values for LCS samples should be within the acceptable limits outlined in the eQAPP.
  - Matrix spike recoveries – PR values for MS samples should be within the acceptable limits outlined in the eQAPP.
  - Laboratory replicate acceptability – laboratory replicate RPDs must be below the acceptable limit outlined in the eQAPP.
  - Surrogate recoveries - PR values for surrogate samples should be within the acceptable limits outlined in the eQAPP.

Table 7. Common quality assurance codes and flagging rules for chemistry data.

Sample Type		QA Code	Code Description	Flagging Business Rules
Environmental Samples	Holding Time	H	A holding time violation has occurred	Apply to each result with the holding time exceeded. Apply to matrix spikes with parent environmental samples. Do not apply to LABQA.
	Dilutions performed	D	EPA Flag - Analytes analyzed at a secondary dilution	Apply to results with a dilution factor greater than 1.
Field QC Samples	Field Blanks	IP/IP5[1]	Analyte detected in method, trip, or equipment blank	Apply to field blank results with a detection above the acceptable limit.
	Field Duplicates	FDP	Field duplicate RPD outside of established limits	Apply to results for both replicates with an RPD above the acceptable limit.
Laboratory QC Samples	LabBlank	IP	Analyte detected in method, trip, or equipment blank	Apply to lab blank result with a detection above the acceptable limit.
	MS/MSD	GB	Matrix spike recovery not within control limits	Apply to MS or MSD result with a percent recovery outside of project QC limits.
	LCS	EUM	LCS recovery is outside of control limits.	Apply to LCS results with a percent recovery outside of project QC limits.
	CRM	GBC	CRM analyte recovery is outside of control limits.	Apply to CRM results with a percent recovery outside of project QC limits.

Sample Type		QA Code	Code Description	Flagging Business Rules
	Laboratory Dup/MSD	IL	Duplicate analysis not within control limits.	Apply to results for both replicates with an RPD above the acceptable limit.
	000NONPJ samples	QAX	When the native sample for the MS/MSD or DUP is not included in the batch reported	Apply to 000NONPJ samples when the native sample is not included in the batch reported.
Surrogates		GN	Surrogate recovery is outside of control limits	Apply to both the surrogate that did not meet QC limits and to the analytes/sample associated to that surrogate. If there are two surrogates performed for a sample and one is outside project QC limits and one is inside QC limits, GN is applied to all analytes for that sample except the surrogate that was inside QC limits.
Rejecting Batches		R	Data rejected - EPA Flag	Apply to all samples within a rejected batch (environmental and QC) that are outside project QC limits and the program QA officer determines to be rejected. (See Rejected Chemistry Results section for details)

[1]The use of the specific "IP" code may vary by project according to the FB evaluation requirements outlined in the QAPP; the determination of the correct code to use is at the discretion of the Project QA Officer.

8. LabBatch Information Updates

The CV RDC business rules applied to most projects when reviewing and updating the LabBatch worksheet within the CEDEN template are as follows:

- **LabSubmissionCode updates**. For data processed by MLJ DMT staff, the Lab Submission Code is updated anytime a QACode other than None is used in a batch. Batches where all results have a QACode of "None" have a LabSubmissionCode of "A" for acceptable. If the batch has any QACode other than "None", "A,MD" is applied indicating acceptable with minor deviations .
- **BatchVerificationCode updates.** Unless otherwise specified, all data processed by MLJ staff according to the steps outlined in this SOP are given a batch verification code of "VAC" indicating a cursory verification was completed.

9. Unique Row Verification

Unique records are verified by completing two checks:

- Ensure that there is only one analyte and fraction for each station, sample date, and sample type for environmental samples, and
- Ensure all required CV RDC fields are unique in the EDD.

10. Chemistry Data Checker

Once the EDD review is complete, the processed EDD is uploaded into a CV RDC/CEDEN online data checker for a verification of business rules and valid values by the MLJ DMT. A data checker is an online tool into which a data provider can upload a populated template to run the data set through a series of automated checks. The data checker provides a report to the data provider via email identifying errors that need to be resolved and issues that need to be reviewed in the submitted EDD. In most cases, errors identified by the data checker are database requirements and must be resolved for the data to be uploaded into the CV RDC database. Other items identified as potential issues with the EDD are warnings which may be project specific or not applicable to the data set. All potential issues identified by the data checker are evaluated and addressed, when applicable, by the MLJ DMT in coordination with the data provider and/or laboratory (as needed) prior to finalizing the EDD and loading it into the CV RDC database (see **Loading Laboratory Results into CV RDC Database**). Processed EDDs may be uploaded to the data checker more than once to ensure all applicable errors and warnings have been successfully corrected. Links to data checkers used for CV RDC data can be found on the MLJ Environmental website; the specific data checker that should be used for an EDD is dependent on the project and the CEDEN template being submitted.

11. Rejected Chemistry Results

Results that do not meet project acceptance criteria must be assessed through the corrective action process (see Corrective Action/Resolution). When corrective actions are assessed and no resolution can be reached the rejection of results that do not meet QC requirements as outlined by the QAPP are left to the discretion of the Project QA Officer. The Project QA Officer works in coordination with data users and any project-specific authorities or regulators to assess the QC failures according to project goals and determine whether results should be rejected.

Results that are rejected by the QA Officer, and are therefore considered unusable for the project goals, are processed and flagged with a QACode of “R” for rejected. Individual rejected results should be formatted as follows:

- The result is removed from the Result column (cell is null) and the ResQualCode updated to “NR”.
- The Lab Result Comments are updated to indicate the original result of the failed sample,
  - Example: “Original result 0.02 ug/L. Batch rejected. See batch comments.”
- An applicable Lab Batch Comment is applied to indicate why the batch and/or result was rejected.
- Appropriate QACode flags, indicating that QC limits that were not met, are applied in addition to the rejected QACode.

If the whole batch is rejected, the following updates are made to the batch-level information:

- The Lab Submission Code is updated with an "R,QC" indicating that the batch is rejected;
- The batch verification code is updated to "VR"; and
- The compliance code is also updated to "Rej" to indicate that the data are rejected and unusable for intended purposes.

12. Chemistry EDD Review MIS Tracking

Once complete, the EDD review should be tracked by adding the staff name (formatted as last name and first initial) and date on which the review was completed in the Laboratory Data Processing table in the MIS Database (**Table 5**).

F. PROCESSING OF TOXICITY EDDS

Like the chemistry EDDs, MLJ DMT staff process individual toxicity EDDs prior to loading them into the CV RDC Database. Each EDD is reviewed following a checklist that has been customized for the specific reporting laboratory, data type, and project when applicable. The fundamental checklist items are described below; a detailed checklist used to process toxicity EDDs is provided in **Attachment B**.

EDD reviews require three items: the EDD, the accompanying PDF laboratory report, and the eQAPP project information.

1. Verify Sample Analysis

Toxicity results should be verified against the sample collection records and the MIS Database according to the same steps outlined above for chemistry results (**Verify Sample Analysis**).

2. Verify Results

Toxicity results should be verified against the final laboratory PDF report according to the same steps outlined above for chemistry results (**Verify Results**).

3. Verify Processing and Analysis Information

All toxicity sample processing and analysis information should be verified against the project-specific requirements outlined in the eQAPP and against the business rules of the CV RDC Database (e.g., correct formatting of the LabBatch identifier**)**. Any discrepancies between the processing and analysis information and the expected requirements in the project eQAPP should be communicated back to the contract laboratory; if applicable, the report should be amended by the laboratory and resubmitted. At a minimum, toxicity results will be checked for:

- Expected ToxBatch formatting utilizing CV RDC batch naming conventions.
- Expected batch grouping – ensure that the ToxBatch is grouped by method and organism.
- Expected test and method information.
- Expected statistical information.
- Expected organisms and endpoints.

4. Calculating Field Duplicate Precision

Field duplicate RPD (or applicable precision evaluation) calculations are not normally provided by the laboratory; these values must be calculated according to the requirements outlined in the QAPP and added to the ToxPointSummaryComments field of the EDD for evaluating field duplicate acceptability. According to CV RDC business rules, the RPD calculation in the ToxPointSummaryComments field should be formatted as "RPD XX" or, for some projects, as "FD RPD XX" for field duplicates.

5. Verify Laboratory Data Quality Control

Toxicity results should be verified against the current MQOs stored in the eQAPP Database. Like chemistry data, any data that do not meet the project acceptability criteria must be flagged with an approved quality assurance flag defined on the CV RDC/CEDEN QA Code LookUp lists. Common quality assurance flags are listed in **Table 8.** All acceptable, unflagged data are assigned a QACode of None to indicate there were no anomalies for which a QACode is required. All records must have QACode field in order to be loaded to the database.

At a minimum, the following QC checks must be performed prior to toxicity data being loaded into the database:

- **Hold time compliance.** Samples are evaluated to ensure they were performed within the designated hold time outlined within the eQAPP.
- **QC sample frequency evaluation.** Depending on the specific requirements outlined in the eQAPP, toxicity batches should be analyzed with at least one negative control (CNEG) sample.
  When QC sample frequency requirements are not met, the LabSubmissionCode is updated to "QI" to indicate incomplete QC. A ToxBatchComments is required to indicate why batch QC frequency was not met.
- **Field QC sample evaluation.** All applicable field QC should be evaluated according to the frequency requirements in the eQAPP. This usually includes (but is not limited to):
  - Field duplicate acceptability – field duplicate RPDs must be below the acceptable limit outlined in the eQAPP.

Table 8. Common quality assurance codes and flagging rules for toxicity data.

Sample Type		QA Code	Code Description	Flagging Business Rules for ToxSummary TestQACode
Environmental Samples	Holding Time	H	A holding time violation has occurred	Apply to each result with the holding time exceeded. Do not apply to LABQA.
	Dilutions performed	D	EPA Flag - Analytes analyzed at a secondary dilution	Apply to results with a dilution other than 100.

SAMPLE TYPE		QA CODE	CODE DESCRIPTION	FLAGGING BUSINESS RULES FOR TOXSUMMARY TESTQACODE
Field QC Samples	Field Duplicates	FDP	Field duplicate RPD outside of established limits	Apply to results for both replicates with an RPD above the acceptable limit.
Laboratory Control Samples	CNEG	TAC	Alternative control used in toxicity statistical analysis	Apply to CNEG that was not utilized in statistical analysis
	CNSL/ CNpH[1]	TCF	Alternative control does not meet test acceptability criteria	Apply to alternative control result that is outside of TAC limits.
Samples with Water Quality Parameter Issues		TCI	Conductivity insufficient for test species	Apply to applicable sample only
		TCT	Conductivity tolerance exceeded for test species	Apply to applicable sample only
		TR	Test conditions not acceptable (temp, light)	Apply to applicable sample only
		TW	Water quality parameters outside recommended test method ranges	Apply to applicable sample only
		TWN	Required water quality parameters not measured	Apply to applicable sample only
		TA	Ammonia precision or accuracy exceeds laboratory control limit	Apply to applicable sample only
Sample with Organism or Survival Issues		PRM	Low survival in toxicity test resulted from test interference due to pathogen-related mortality	Apply to applicable sample only
		TOQ	Number of organisms in a toxicity test do not meet the minimum quantity per replicate at test initiation or an unequal quantity of organisms per replicate is used	Apply to applicable sample only. Ensure OrganismPerRep is correct.
		TAE	Organism exceeds age limit	Apply to applicable sample only

SAMPLE TYPE	QA CODE	CODE DESCRIPTION	FLAGGING BUSINESS RULES FOR TOXSUMMARY TESTQACODE
Replicate Issues	RLST	Replicate lost or destroyed	Apply to applicable sample only. Ensure RepCount is adjusted accordingly.
Rejecting Batches	R	Data rejected - EPA Flag	Apply to all samples within a rejected batch (environmental and QC) that are outside project QC limits and the program QA officer determines to be rejected. (See **Rejected Toxicity Results** section for details)

6. ToxBatch Information Updates

ToxBatch information should be populated according to CV RDC business rules as outlined in the chemistry section; see **LabBatch Information Updates** section above.

7. Toxicity Unique Row Verification

Unique records are verified by completing two checks:

- Ensure that there is only one organism and endpoint for each station, sample date and sample type for environmental samples, and
- Ensure all required CV RDC fields are unique in the EDD.

8. Toxicity Data Checker

Once the EDD review is complete, toxicity results should be uploaded to the CV RDC/CEDEN data checkers according to the same steps outlined for chemistry data above (**Chemistry Data Checker**).

9. Rejected Toxicity Results

Results that do not meet project acceptance criteria must be assessed through the corrective action process (see Corrective Action/Resolution). When corrective actions are assessed and no resolution can be reached the rejection of results that do not meet QC requirements as outlined by the QAPP are left to the discretion of the Project QA Officer. The Project QA Officer works in coordination with data users and any project-specific authorities or regulators to assess the QC failures according to project goals and determine whether results should be rejected.

Results that are rejected by the QA Officer are considered unusable for the project goals and are processed with other results and flagged with a QACode of “R” for rejected. Individual rejected toxicity results should be formatted as follows:

- PercentEffect is removed (cell is null),
- SigEffect updated to “NA”
- TestQACode updated to “R”

- ComplianceCode as “REJ”
- The mean is left as is with the mean populated
- The tox point summary comments are updated to indicate why the samples were rejected
  - Example: “Control did not meet test acceptability criteria. Rejected data.”
- An applicable tox batch comment is applied to indicate why the batch or sample was rejected.
- Appropriate QACode flags, indicating that QC limits that were not met, are applied in addition to the rejected QACode.

If the whole batch is rejected, the following updates are made to the batch-level information:

- The LabSubmissionCode is updated with an “R,QC” indicating that the batch is rejected,
- The BatchVerificationCode is updated to “VAC,VCN” (Cursory Verification, Tox Control Failure, Flagged by QAO),
- The ComplianceCode is updated to “Rej” to indicate that the data is rejected and unusable for all intended purposes.

10. Toxicity EDD Review MIS Tracking

Once complete, the EDD review should be tracked by adding the staff name (formatted as last name and first initial) and date on which the review was completed in the Laboratory Data Processing table in the MIS Database (**Table 5**).

G. PROCESSING OF TISSUE EDDS

Prior to loading a tissue EDD into the CV RDC database, each EDD is reviewed following a checklist that has been customized for the specific reporting laboratory, data type, and project (when applicable). The fundamental checklist items are described below; the detailed checklist used to process chemistry EDDs is provided in **Attachment C**.

EDD reviews require three items: the EDD, the accompanying PDF laboratory report and eQAPP project information.

Tissue EDD processing follows the same steps outlined above in the **Processing of Chemistry EDDs** section; the major exception is the review of the sample composite information outlined below. The composite review steps are completed first, then the steps for chemistry EDDs can be followed to compete the process.

1. Fish Composite

For fish tissue samples the below items on the tissue template fish composite worksheet must be reviewed for accuracy, consistency and adherence to CV RDC business rules:

- Ensure sample and collection information matches field data entry (Columns A -N).
- Ensure TisSource is “NA”.
- Ensure Organism IDs follow a recognizable, consistent convention for the program.
- If fork and total length are recorded, ensure the total length is larger than fork length.

- If the project is a human health study, ensure that the smallest fish total length is no more than 20% difference compared to the largest fish total length (if applicable according to the QAPP).
- Review for extreme or erroneous values for fork length, total length, and weight of fish.
- Ensure TissueID's follow a recognizable, consistent convention for the program.
- Ensure TissueName and PartsPrepPreservationName matches tissue processing procedures in QAPP.
- Review the tissue weight against the weight of fish to ensure the tissue weights are lower (or similar where the whole fish was used).
- Ensure CompositeIDs follow a recognizable, consistent convention for the program. Often CompositeIDs should include the StationCode, sample date, and organism reference. If the program has individual vs composite samples typically "I" or "C" are referenced in the CompositeID.
- Ensure that the CompositeWeight, CompositeType, CompositeReplicate, UnitCompositeWeight, HomogDate, OrganismGroup, ComAgencyCode are the same for each CompositeID.
- Review the individual organism weights against the CompositeWeights and ensure there are no extreme or erroneous values.

2. Bivalve Composite

For bivalve tissue samples the below items on the tissue template bivalve composite worksheet must be reviewed for accuracy, consistency, and adherence to business rules:

- Ensure sample and collection information matches field data entry (Columns A -N).
- Ensure TisSource is "Resident" or "Transplant".
- Ensure OrganismID's follow a recognizable, consistent convention for the program.
- Ensure ShellLength, ShellWidth and LengthWidthType are consistent; check for extreme or erroneous values.
- Ensure individual bivalve measurements are provided. If the program is not reporting individual bivalve measurements, ensure QAPP allows for averaging measurements.
- Ensure TissueID's follow a recognizable, consistent convention for the program.
- Ensure TissueName and PartsPrepPreservationName match tissue processing procedures in QAPP.
- Review for erroneous values for tissue weight compared to organism weight (if reported).
- Ensure the CompositeIDs follow a recognizable, consistent convention for the program. CompositeIDs should include StationCode, sample date, and organism reference. If the program has individual vs composite samples typically "I" or "C" are referenced in the CompositeID.
- Ensure that the CompositeWeight, CompositeType, CompositeReplicate, UnitCompositeWeight, HomogDate, OrganismGroup, ComAgencyCode are the same for each CompositeID.
- Review the individual organism weights against the CompositeWeights and ensure there are no extreme or erroneous values.

3. Super Composite

For super composite samples the below items on the tissue template super composite worksheet must be reviewed for ensure accuracy, consistency, and adherence to business rules:

- Ensure CompositeSourceID matches ID from original composite worksheet.
- Ensure CompositeType, CompositeReplicate, CompositeWeight and UnitCompositeWeight are the same for each SuperCompositeID.
- Ensure SuperCompositeIDs follow a recognizable, consistent convention for the program.
- Ensure CompositeType equals “super”.

4. Verify Tissue Result

When verifying tissue chemistry results follow the steps outlined in the **Verify Results** section above for processing chemistry EDDs. In addition to those steps, tissue results must also be checked for the following:

- Ensure SampleTypeCode equals “Composite”.
- Ensure the CompositeID matches between results worksheet and corresponding composite worksheet.
- Ensure OrganismGroup is applicable to the corresponding type of composite.

5. Verify Processing and Analysis Information

Processing and analysis information should be verified according to the **Verify Processing and Analysis Information** steps outlined for chemistry EDDs.

6. Verify Formatting

Formatting should be verified according to the **Verify Formatting** steps outlined for chemistry EDDs.

7. Verify Laboratory Data Quality Control

Laboratory data quality control samples are verified according to the **Verify Laboratory Data Quality Control** steps outlined for chemistry EDDs.

8. LabBatch Information Updates

Laboratory batch information should be process according to the **LabBatch Information Updates** steps outlined for chemistry EDDs.

9. Unique Row Verification

Unique row checks for tissue data are run according to the **Unique Row Verification** steps outlined for chemistry EDDs.

10. Tissue Chemistry Data Checker

Tissue data are run through data checkers according to the **Chemistry Data Checker** steps outlined for chemistry EDDs.

11. Rejected Tissue Chemistry Results

Results that do not meet project acceptance criteria must be assessed through the corrective action process (see Corrective Action/Resolution). When corrective actions are assessed and no resolution can be reached the rejection of results that do not meet QC requirements as outlined by the QAPP are left to the discretion of the Project QA Officer. The Project QA Officer works in coordination with data users and any project-specific authorities or regulators to assess the QC failures according to project goals and determine whether results should be rejected.

Tissue chemistry data are rejected and coded according to the **Rejected Chemistry Results** steps outlined for chemistry EDDs.

12. Chemistry EDD Review MIS Tracking

Once complete, the EDD review should be tracked by adding the staff name (formatted as last name and first initial) and date on which the review was completed in the Laboratory Data Processing table in the MIS Database (**Table 5**).

H. CORRECTIVE ACTION/RESOLUTION

Results that fail to meet project acceptance criteria due to errors in the field or lab trigger the initiation of the corrective action process. While the specific process may vary by project, there are four general steps that should be followed to complete this process:

1. Identification of the error or deviation,
2. Documentation and tracking,
3. Investigation of the root cause, and
4. Review/follow up to assess if the error has been successfully corrected.

As the MLJ DMT staff are the first reviewers of data received from laboratories, they are primarily involved in the identification and documentation of errors and deviations.

When errors are found in either the PDF report or the EDD file which prevent the data from being processed and/or loaded into the database, the following actions should be performed:

- The appropriate laboratory will be contacted regarding the issue(s) requiring resolution and sent a copy of the data file to use as a reference if needed.
- If the issue requires a resubmission, a revised data file and/or hardcopy report will be requested from the laboratory.

All minor issues will be revised by the MLJ DMT staff in the EDD file; the laboratory must be notified of any changes to the final data file prior to loading.

Similarly, for field deviations/errors identified during the data review process, the field crew and project manager will be notified, and any additional actions discussed for correcting the data and preventing similar issues in the future.

Any laboratory errors that cannot be resolved by an updated report or data file must be reviewed by the QA Officer and assessed for the necessity of further investigation or resolution.

The QA Officer works with the labs to establish proper documentation and corrective actions for laboratory errors.

For most projects, follow up reviews of implemented corrective actions occur on two levels:

1. Summaries and reviews of corrective actions are provided to data users and regulators through annual QA assessment reports, and
2. Reviews with laboratory staff occur through annual meetings conducted by the QA Officer and data managers assessing performance and data needs.

The associated QAPP provides additional guidance regarding project-specific corrective actions and should be referenced when determining the level to which step 3 and 4 should be implemented.

I. PROVIDING CHEMISTRY RESULTS FOR TOXIC TOXICITY RESULTS (PHASE III TIE)

For certain projects, toxicity samples in which the organisms exhibit a certain amount of toxic effect may require further investigation as to the source of the toxicity in the samples. Toxicity Identification Evaluations (TIEs) may be performed and, as part of a Phase III TIE, chemistry results can be used to evaluate the toxic effect of specific analytes detected in the sample. When a TIE is triggered (according to limits defined by the program requirements), MLJ DMT staff provide relevant chemistry data associated with the sample that is determined to be toxic to one or more organisms, back to the toxicity laboratory so that a Phase III TIE can be completed.

If there are relevant chemistry results available to send back to the laboratory, MLJ DMT staff export these results into a Phase III TIE chemistry data template once the originally reported results have been verified and loaded into the database. The Laboratory Data Processing table in the MIS Database is updated to reflect that chemistry results were sent to the laboratory. The laboratory uses the data provided to calculate the toxic units of any detected analytes for the TIE investigation summary in the final laboratory report.

J. LOADING LABORATORY RESULTS INTO CV RDC DATABASE

Once an EDD is processed and verified (the checklist is completed and any remaining laboratory questions are answered and updated), the EDD is placed in a queue for loading into the CV RDC Database. Prior to loading, EDDs should be double-check by one additional staff member to ensure the data processing steps have been completed as outlined above. MLJ DMT staff follow internal SOPs specific to loading chemistry, toxicity, and tissue EDDs into the CV RDC database. Completion of each of these steps are tracked in the Laboratory Data Processing table of the MIS Database.

Data are loaded using a series of queries to add the results to the CV RDC relational database design. Automated checks are performed on the data prior to loading to ensure that results are unique, assigned to the correct sample collection information, formatted correctly, contain the correct valid values, and that all required fields are populated. Result table counts are tracked

prior to loading and compared to counts after loading to ensure all intended results were uploaded. After the EDD is loaded, specific verification steps are performed to ensure the correct results have been added into the CV RDC database. Basic data queries are run after all results are loaded to verify the correct permissions and usability codes are on the results.

Any discrepancies will be noted and communicated back to the Project Manager and Project QA Officer to be reconciled. The loaded EDD is filed in the appropriate internal system as described above (**Receipt and Filing of Laboratory Results**); loaded copies of EDDs containing any updates that occurred during data processing are saved with the end of the file name updated to indicate it was loaded and the date it was uploaded (e.g., "_LOADED_071821").

Once complete, the loaded EDD should be tracked by adding the staff name (formatted as last name and first initial) and date on which loading was completed in the Laboratory Data Processing table in the MIS Database (**Table 5**).

VIII. DATA FINALIZATION AND PUBLICATION

A. INTERNAL DATA REVIEW

Prior to project deliverables and reporting of the project data set, the data in the CV RDC database is compared to information in the MIS to check for completeness, ensure specific business rules are applied, verify WQTL exceedances reported for applicable projects, and ensure data output for Project Managers and reports are exporting correctly. The main checks include:

- Ensure Analysis Count table in the MIS Database is marked correctly for sample collection and analysis completion (**Table 1**).
- Ensure completeness assessments in the MIS Database agree with the data loaded into the CV RDC.
- Ensure exceedances identified during the **Initial Laboratory PDF Review** section match the final results in the CV RDC.
- Verify that field results are within the expected range; results are queried against the general limits (depending on the project and/or region) to determine if they are outside of the range expected for the measurement.
    - If a field result is outside the specified limits, verify the value against the original fieldsheet to ensure it is not the result of a transcription error.
    - Any results identified as unlikely based on the specified limits and verified with the field sheet should be discussed with the Project Manager and QA Officer to determine if the result is usable.
        - It may be the case that the result is determined to be legitimately outside of the normal range based on further site-specific information or anomalous sampling conditions. If the result is determined to be useable, no further data qualifiers are required, though a note should be added to the comment field specifying that the result is useable.
        - Values determined to be suspect should be updated to a null value with a ResQualCode of "NR", a QA code of “FIF” for Instrument Failure, and a specific comment including the original suspect result that was removed (e.g., "Value recorded as 45mg/L, suspected instrument failure").
- Ensure business rules for field entry have been correctly applied such as ResQualCodes and QACodes.

B. UPDATE CV RDC DATA FROM PRELIMINARY TO PERMANENT

Every result table in the CV RDC Database has a status column that indicates if the record is preliminary or permanent data. Permanent data have been fully reviewed and finalized; in most cases the finalization of the data is associated with the completion of an associated data report. If the data are to be made publicly available, permanent data are ready to be transferred to

CEDEN. Some data may be kept internal depending on the project and are not transferred to CEDEN; these data are qualified with an appropriate status as outlined in **Table 9**.

Preliminary data are working data that have not been fully reviewed and/or finalized. Preliminary data must undergo a final review and be approved for finalization before being considered permanent. The specific valid values used to indicate these statuses are outlined in **Table 9**.

Each data set that is ready to be finalized will undergo a series of global query checks which ensure that the data submitted follow the documented CV RDC business rules. If any discrepancy is found during a review, MLJ DMT staff will discuss the discrepancy with the appropriate person. Discussion will cover whether the information collected is accurate, what the cause(s) leading to the deviation may be, how the deviation might impact data quality, and what corrective actions might be considered.

Once all the global query checks have been performed and documented, MLJ DMT staff will update the status of each record to indicate it is permanent data and notify the Project Manager.

Table 9. Status field valid values used in the CV RDC.

STATUS VALID VALUE	TRANSFER TO CEDEN	STATUS DESCRIPTION
CEDEN_Entry_CVRDC	No	Used for preliminary CV RDC data to be eventually exported to CEDEN, transfer to CEDEN cannot occur until the data are updated to permanent.
CEDEN_Perm_CVRDC	Yes	Used for permanent CV RDC data to be exported to CEDEN.
CVRDC_Entry	No	Used for internal preliminary CV RDC data not to be exported.
CVRDC_Perm	No	Used for internal permanent CV RDC data not to be exported.

C. TRANSFER DATA FROM THE CV RDC TO CEDEN

Data cannot be transferred to CEDEN until the status is marked as permanent, indicating it has undergone global query checks, and that it is intended to be published in CEDEN (**Table 9**). When data are finalized and ready for transfer, the MLJ DMT will receive final approval from the Project Manager. The Project Manager will receive an Excel file that summarizes the data to be transferred and provides result counts. All data transfers to CEDEN will be recorded and documented. Once the transfer is complete, the Project Managers will be notified.

Data should be transferred to CEDEN once any final reports including an assessment and interpretation of the associated results have been submitted to regulators and/or data users (unless specified otherwise by the project requirements). For most projects, this occurs on an annual basis. The MLJ DMT generally publish finalized data to CEDEN within 1-2 months of report submittal. Excessive delays are generally not expected seeing as finalized, permanent data in the CV RDC do not need to undergo further data checks or verification steps prior to being transferred to CEDEN. If delays past this time period are to be expected, the reasons for the delay along with an expected timeline for publication should be provided to the data users.

In addition to updating the status of each record to “CEDEN_Perm_CVRDC”, several other fields in the CV RDC must be updated for any data that are data intended for CEDEN to ultimately be

transferred. The following fields must be updated appropriately for the final CEDEN transfer to occur:

- Status,
- DataToBeExported,
- CollectionComplete, and
- Public.

Once datasets are appropriately updated in the CV RDC Database, the data will automatically be uploaded to CEDEN during the weekly synchronization that occurs every Saturday morning. This process is performed using automated run statements managed by MLML-MPSL.

In addition to the correct data coding in the CV RDC, MLJ DMT staff must also notify the CEDEN DMT to update the project lookup list to indicate the project is public; this step allows the data to be visible on any CEDEN export tool.

Any updates to CV RDC data that have already been transferred to CEDEN are synchronized with CEDEN on a weekly basis. Any significant changes to data in the CV RDC that affect results or the interpretation of results (e.g., sample location) are communicated to CEDEN staff and the agency associated with the project through the use of the CEDEN Data Modification Request Form (http://ceden.org/procedures.shtml). The Request Form serves as official notification to CEDEN staff that the change will occur; the changes will be implemented during the database synchronization unless concerns are raised during the notification process. Minor changes (e.g., spelling or formatting changes to comment fields) do not require that CEDEN be notified. All changes to data that have already been published, both significant and insignificant, are reviewed by the Project QA Officer and documented internally by the MLJ DMT.

ATTACHMENT A. MLJ ENVIRONMENTALCHEMISTRY ANALYSIS REVIEW CHECKLIST

MLJ Water Chemistry Analysis Checklist

Item No.			Component Name	Verified (No	Verified	Fixes Needed	Not Applicable	Comments
1			**Results Check**					
	1.1		Verify Results with the PDF					
		1.1.1	Check 10% of the results. Filter on the sample information to ensure that the sample information lines up with the results. If the 10% check is all correct, then proceed with processing the EDD. If errors are found, check all results against the PDF.					
		1.1.2	Check the case narrative in each PDF for important information about reanalysis, hold time violations, or anything that appears out of the ordinary that could affect specific samples or the entire batch. Paste snips of pertinent information into the LaboratoryQuestions tab, and update LabResultsComments if necessary.					
2			Sample Information					
	2.1		Coalition Samples (Grab, field duplicates, field blanks, matrix spikes)					
		2.1.1	Lab Sample Details: Compare sample collection information from the database to the EDD to verify they are the same.					
3			Processing and Analysis Information					
	3.1		Lab Batches					
		3.1.1	Batch names should conform to the CV RDC batch naming guidelines, stored here: X:\P_CV_RDC\Management_Documentation\2_Documentation_EntryManuals\File-BatchName (or online at CV RDC batch naming conventions).					
		3.1.2	Batches are defined by Method. Each batch should have same Units (excluding surrogates) and Analysis Date. Analysis Dates in a batch should be within 24 hours of each other; if there is a Digest Date then digests/extractions should all be within 24 hours.					
	3.2		Matrix Name					
		3.2.1	When an MS is performed off blankwater, add the following comment to the CollectionComments. Include the period: “MS performed on FieldBlank.”					
	3.3		Method Name, Analyte Name, Fraction Name, Unit, MDL and RL					
		3.3.1	Each method, analyte, fraction and unit should have the correct Preparation & Digestion methods reported. Review the eQAPP to verify.					
	3.5		ExpectedValue					
		3.5.1	All MS, LCS, CRM or Surrogate samples should have an expected value.					
	3.6		LabSampleComments					
		3.6.1	LabReplicates of 2 should have an RPD (Relative Percent Difference) recorded (excluding surrogate samples).					
		3.6.2	All LCS and MS samples should have a PR (Percent Recovery) recorded.					
		3.6.3	Check the correct format for PR and RPD was applied: use “PR XX” or “RPD XX”; when in combination (such as for an MSD), use “PR XX, RPD XX” (e.g., PR 99, RPD 5)					

ITEM NO.			COMPONENT NAME	VERIFIED (NO VERIFIED FIXES NEEDED)	NOT APPLICABLE	COMMENTS
		3.6.4	Calculate Field Duplicate RPDs: Calculate RPD for FieldDup (replicate of 2) and its associated environmental sample: Round results to TWO sig figs (unless 3 digits: i.e., 24, 2.5 163). See QAPP for calculation; example ABS((X-Y)/(X+Y))*100 (where X = env sample result and Y = fielddup result). FD RPD calculations do NOT apply to surrogates (unit=%). For ND results, enter "FD RPD NA" (if either the environmental sample or the field duplicate is ND) If RPD values equal zero (both replicates have the same positive value), use "FD RPD 0" (Project Specific: label only FD sample with "FD RPD XX")			
		3.6.5	Flag FD RPD (If Applicable): If the calculated RPD is outside limits, flag the FieldDup AND environmental sample with a QACode of "FDP". See eQAPP for project specific limits.			
		3.6.6	If the EDD includes bacteria results (E. coli) Calculate Field Duplicate/LabRep Rlog: W:\P_ILRP\2.3_DataMgmt\6_ReviewEDDs\EDDChecking\Rlog_calcs\2018 WY. If one sample is ND then enter "Rlog NA". If one sample is >2419.6 enter "Rlog NA". Remove FD RPD that is calculated by the lab and replace with Rlog you calculated as per eQAPP.			
	3.7		Submitting Agency			
		3.7.1	Submitting Agency is MLJ Environmental			
	3.8		BatchVerificationCode			
		3.8.1	Populate BatchVerificationCode column with VAC if all checks within this checklist are performed.			
4			QA Checks			
	4.1		Batch Amount Check: Verify laboratory batches have the correct amount of QC required by the QAPP; if QC is missing batch is appropriately flagged with a LabSubmissionCode of QI and a lab batch comment is included. (Verify with lab first as to why it is missing)			
	4.2		Hold Time Check: Check extraction/analysis occurred within the appropriate holding times; if holding times were not met the batch is appropriately flagged and a lab batch comment is included.			

ITEM NO.			COMPONENT NAME	VERIFIED (NO VERIFIED FIXES NEEDED)	NOT APPLICABLE	COMMENTS
	4.3		FieldBlank Check: (or any project blank samples) If a field blank flag is required notify QA Officer. Potentially need to reanalyze samples. If lab reanalyzed samples to confirm ensure LabResultComments indicates so. Project Specific: 1) Check that FieldBlanks meet eQAPP limits 2) If equal to or >RL, check if FB results is <1/5 env sample 3) If <1/5 env sample, leave QACode as None and add LabResultComments "<1/5 env sample, env sample=XX" 4) If >1/5 env sample, change QACode to IP5 and add LabResultComments ">1/5 env sample, env sample=XX" 5) For flagged samples, add LabBatchComm "Analyte detected in fieldblank (">1/5 env sample, env sample=XX)."				
	4.4		Laboratory QC Check: Laboratory QC (MS, LCS, MSD, Lab Blank, Lab Duplicates) Verify samples are within the eQAPP requirements; if QC is outside of requirements the batch is appropriately flagged and a lab batch comment is included. Verify LabBlanks, Matrix Spikes, Lab duplicates and LCS's and any other specific MQO's according to eQAPP.				
	4.5		LabBatch Comments Check: Once all QACodes are applied use a pivot table to verify that LabBatch comments reflect all QACodes in the Results tab. (Make sure to refresh pivot table before check and use the Standardized LabBatchComments.) Check that all QC issues explained at beginning of report are recorded in EDD with either a QACode or in the batch comment. Standardized LabBatchComments excel file is located here: W:\P_ILRP\2.3_DataMgmt\6_ReviewEDDs\EDDChecking				
	4.6		Project Specific: Look at LabReplicates: similar to Field Duplicates, if either lab results are ND, the RPD values should be NA. Change the value the lab has calculated to RPD NA if either rep 1 or rep 2 has a result of ND.				
	4.7		LabSubmissionCode Check: If the batch has any QACode other than "None", labbatch CANNOT be "A"; should be "A,MD" with a batch comment explaining the code; note that there is NO space between the "A," and "MD".				
	4.8		Lab Report qualifiers: double the check PDF lab report and make sure any appropriate qualifiers are added to either the result or batch comments.				
5			Unique Row Check			
	5.1		Unique Row: Verify that each row is unique. Sample and database unique.				
6			Data Checker			
	6.1		Data Checker: Run file through data checker and resolve any issues. http://checker.cv.mpsl.mlml.calstate.edu/CVRDC/CVRDCUpload.php. When errors are found run through data checker again until all applicable items are resolved. For CEDEN template use: http://ceden.org/CEDEN_checker/Checker/CEDENUpload.php				
	6.2		LabBatch naming convention changed. Verify less than 50 characters (max for the database). The data checker will show an error for anything over 35 characters, which is ok. No action necessary to change if under 50 characters.				
7			Tracking			
	7.1		Counts: Refresh pivot table for counting analytes for each environmental sample. Update analysis count in MIS ensure all analytes expected were received.				

ITEM NO.			COMPONENT NAME	VERIFIED (NO VERIFIED	FIXES NEEDED	NOT APPLICABLE	COMMENTS
	7.2		Tracking: Update MIS, LaboratoryDataProcessing group, qry2_ReportEDDProcessing with date EDD is complete and your name.				

ATTACHMENT B. MLJ ENVIRONMENTAL TOXICITY ANALYSIS REVIEW CHECKLIST

MLJ Toxicity Analysis Checklist

Delta RMP Version 1.0, Last updated on September 1, 2021

Item No.			Component Name	Verified (No	Verified	Fixes Needed	Not- Applicable	Comments
1			Summary and Replicate Results Check					
	1.1		Verify Summary Results with the PDF					
		1.1.1	Check the Mean					
		1.1.2	Check the Percent Control					
		1.1.3	Check the SigEffect: The field cannot be empty- for LABQAs it is "NA" NSG= not significant, greater than threshold SG= significant, greater than threshold NSL=not significant, less than threshold SL= significant, less than threshold					
		1.1.4	For information about TIEs reference the report to correctly format the comment. Project Specific: TIENarrative: Any sample that is SL with a PctControl less then (<) 50% should have a TIE run (excluding not applicable Field duplicate samples see comment below for this situation). To check if chemistry has been done on our end, check: W:\2.3_DataMgmt\2.1_ResultDetails_PhaseIII_TIE. The comment should include any TIE comments/conclusions if a TIE was run: "A TIE was conducted on XX/XX/XX and it was concluded that X was the cause of toxicity." "No TIE was conducted due to…" (Do not apply this comment to samples with a percent effect greater than 50%) "No TIE was conducted on field duplicate due to the TIE being performed on environmental sample."					
	1.2		Verify WQ Replicate Results with pdf					
		1.2.1	Double Check WQ Results using the P_WQResults: 1) Check WQ Results against the PDF (Copy the P_WQResults into new Workbook) 2) Check high low results: Check the high/low values are correct. Use the formulas contained in the TOXEDD_WQMeasurement_HighLowCheck excel file (newer EDDs may have hi/low tab in EDD) located in the checklist folder: W:\2.3_DataMgmt\6_ReviewEDDs\EDDChecking\EDDChecklists (Notes for Sediment: Conductivity, DO, Temp and pH can be checked using the individual water quality measurement data sheets, and Ammonia is found on a separate sheet (Total Ammonia Analysis, check Day0 and Day10 ammonia values).					

ITEM NO.			COMPONENT NAME	VERIFIED (NO	VERIFIED	FIXES NEEDED	NOT- APPLICABLE	COMMENTS
		1.2.2	ResQualCode: "=" (default); "ND" (non-detect); or "NR" for results that were not recorded (due to replicate loss; not required by the program; or by negligence). "NSI" (no surviving individuals) ResQualCode to be applied if a chronic endpoint could not be recorded due to 100% mortality in a replicate and the values should be added to the datasheet if they are missing.					
	1.3		Samples (Grab, field duplicates, field blanks)					
		1.3.1	Lab Sample Details: Compare sample collection information from the database to EDD to verify elements are the same.					
	1.4		Laboratory Quality Assurance Samples (Control Samples)					
		1.4.1	Check the AgencyCode is in the AgencyCodeLookup list and is the Laboratory that created the sample.					
		1.4.2	Project Specific: Check TAccC (Test Acceptibility Criteria) are met (see Section 9 of this checklist for DRMP specific TAccC criteria).					
		1.4.2	UnitCollectionDepth = m (for water) or cm (for sediment).					
2			Processing and Analysis Information (For Summary and Results Tab)					
	2.1		Collection Information					
		2.1.1	Project Specific: Check Protocol Code is correct for individual project.					
		2.1.2	Project Specific: Agency Code = Sampling Agency for environmental samples and Lab Agency for LABQA samples.					
		2.1.3	Check the GeometryShape = "Point" for env. samples or is left blank for LABQA samples					
		2.1.4	Project Specific: Check the CollectionDeviceName = “Individual bottle by hand” or "Individual bottle by USGS-PFRG weighted sampler"; or "None" for LABQA.					
		2.1.5	PositionWaterColumn = "Subsurface" (water) or "Not Applicable" (LABQA or Sediment)					
	2.2		Toxicity Batch					
		2.2.1	Batch names should conform to the CV RDC batch naming guidelines, stored here: X:\P_CV_RDC\Management_Documentation\2_Documentation_EntryManuals\File-BatchName (or online at CV RDC batch naming conventions).					
		2.2.2	Batches are grouped by OrganismName and Method; and include supporting QA samples.					
	2.3		MatrixName, Method Name, Test Duration, Organism Name, Test Exposure Type, QA Control ID, Treatment, Concentration, Unit Treatment, Analyte Name, Unit Analyte, QA Code, Compliance Code					
		2.3.1	Matrix Name: "samplewater" (env. Sample) or "labwater" (LABQA sample)					
		2.3.2	Check the MethodName matches the requirements for the specific organism in the QAPP.					
		2.3.3	TestDuration: Check test duration matches the requirements of the method used.					
		2.3.4	Check the OrganismName matches the lookup list					
		2.3.5	Project Specific: TestExposureType = Chronic or Acute. Check Test Exposure Type reported is appropriate for the method used per the QAPP.					

ITEM NO.			COMPONENT NAME	VERIFIED (NO	VERIFIED	FIXES NEEDED	NOT- APPLICABLE	COMMENTS
		2.3.6	QA Control ID = LabSampleID of Control used for statistical analysis. Use "Control" if left blank by laboratory.					
		2.3.7	Project Specific: Treatment = “None” if no Treatment is applied. Otherwise, check if Treatment reported is appropriate per the QAPP.					
		2.3.8	Project Specific: Concentration = “0” if no Treatment is reported. If a Treatment is applied, check that the Concentration is appropriate per the QAPP.					
		2.3.9	Project Specific: UnitTreatment = “None” if no Treatment is applied. Otherwise, check if TreatmentUnit reported is appropriate per the QAPP.					
		2.3.10	Dilution = 100					
		2.3.11	Project Specific: AnalyteName = Check Analyte Name matches desired endpoints per the QAPP.					
		2.3.12	Project Specific: UnitAnalyte = Check Unit of Analyte matches desired units for endpoints per the QAPP.					
		2.3.13	QACode = "None" unless there was a deviation from expected test parameters. Refer to CEDEN lookup lists to verify any QACodes reported by the lab other than "None".					
		2.3.14	Project Specific: Compliance code = COM or PEND, depending on chain of review for the individual project					
3			Processing and Analysis Information - Summary Worksheet Only					
	3.1		Analysis Check					
		3.1.1	WQSource = Not Applicable (default)					
		3.1.2	ToxPointMethod = None (default)					
		3.1.3	Project Specific: AnalyteName = Check Analyte Name matches desired endpoints per the QAPP.					
		3.1.4	Fraction = None (default)					
		3.1.5	Project Specific: UnitAnalyte = Check Unit of Analyte matches desired units for endpoints per the QAPP.					
		3.1.6	Project Specific: Time Point = Check Time Points required per QAPP					
		3.1.7	Project Specific: Replicate Count = Replicate Count required per QAPP					
		3.1.8	Statistical Method =T-test or Mann-U (when applicable) or Fisher (when applicable)					
		3.1.9	Percent of Control and Effect values are calculated for all environmental samples. Compare to those listed in Lab Report.					
		3.1.10	Sig Effect is found in the SigEffectLookup (NA = LABQA)					
	3.2		ToxPointSummaryComments					

ITEM NO.			COMPONENT NAME	VERIFIED (NO	VERIFIED	FIXES NEEDED	NOT- APPLICABLE	COMMENTS
		3.2.1	Calculate Field Duplicate Relative Percent Difference (RPD) for field duplicates (Grab rep 2) and its associate environmental sample: See QAPP for calculation; example ABS((X-Y)/(X+Y))*100 (where X = env sample result and Y = field dup result). If RPD values equal zero (both replicates have the same positive value), use “RPD 0”. (Project Specific: label only FD sample as "FD RPD XX"					
		3.2.2	Flag FD RPD (If Applicable): If the calculated FD RPD is outside limits, flag the FieldDup AND environmental sample with a QACode of “FDP”. See eQAPP for project specific limits.					
4			QA Checks					
	4.1		Laboratory batches have the correct amount of QC required by the QAPP. Each batch must have a control with it.					
	4.2		Hold Time Check: Check that all analyses were run within the appropriate holding times. If holding times were not met a QA Code of "H" is to be entered in TestQACode field in SUMMARY TAB ONLY (not Replicate tab).					
5			Toxicity Batch Worksheet					
	5.1		Submitting Agency					
		5.1.1	Project Specific: Submitting Agency is “MLJ Environmental” unless specified otherwise by the project manager.					
	5.2		LabSubmissionCode					
		5.2.1	If batch has a QACode other than “None”, lab batch CANNOT be “A”; should be “A,MD” with a batch comment explaining the code; note that there is NO space between the A, and MD.					
	5.3		ToxBatchComments					
		5.3.1	Include lab batch comment explaining any QACode associated with the batch. If no code, leave blank.					
		5.3.2	Project Specific: Depending on chain of review for individual projects, populate BatchVerificationCode column with “NR”; the final verification will be done by MLM who will apply “VAC” after their final review.					
6			Unique Row Check					
	6.1		Unique Row: Verify that each row is unique for the Summary tab.					
	6.2		Unique Row: Verify that each row is unique for the Results tab.					
7			Data Checker					
	7.1		Data Checker: Run file through data checker and resolve any issues. http://checker.cv.mpsl.mlml.calstate.edu/CVRDC/CVRDCUpload.php.					
8			Tracking					

ITEM NO.			COMPONENT NAME	VERIFIED (NO	VERIFIED	FIXES NEEDED	NOT- APPLICABLE	COMMENTS
	8.1		Counts: Compare counts in EDD to those in the MIS to ensure all organisms and endpoints are accounted for.					
	8.2		Tracking: Update MIS for count verification and review completion.					
9			Test Acceptability Criteria (TAccC) (DRMP Specific)					
	9.1		Check for TAccC					
		9.1.1	*H. azteca* (96 hr): ≥ 90% mean survival in controls					
		9.1.2	*H. azteca* (10 day): ≥ 80% mean survival in controls and measurable growth					
		9.1.3	*C. dilutes* (10 day): ≥ 80% mean survival in controls and an average of ≥ 0.60 mg ash-free dry weight for surviving individuals					
		9.1.4	*P. promelas* (7 day): ≥80% mean survival in controls and an average of ≥ 0.25 mg ash-free dry weight for surviving individuals					
		9.1.5	*C. dubia* (6-8 day): ≥80% control survival and 60% of the surviving control females must produce 3 broods with an average of 15 or more young per surviving female					
		9.1.6	*S. capricornutum* (96-hour): (without EDTA) mean cell density of at least $2x10^5$ cells/mL in controls and variability (CV%) among control replicates ≤20%					
10			Salinity (DRMP specific)					
	10.1		For *C. dubia*: if there is an environmental sample that has a conductivity of ≤ 130 µS/cm make sure that a low conductivity tolerance control is run (CNSL).					
	10.2		If a low conductivity tolerance control is run (CNSL), but it does not meet TAC, the sample is compared to the regular CNEG and the following comment applied: "Tolerance control based on sample conductivity did not meet test acceptability criteria; percent effect based on comparison with standard control. Effects may include response to low EC in sample." QACode: TW (Water quality parameters outside recommended test method ranges)					

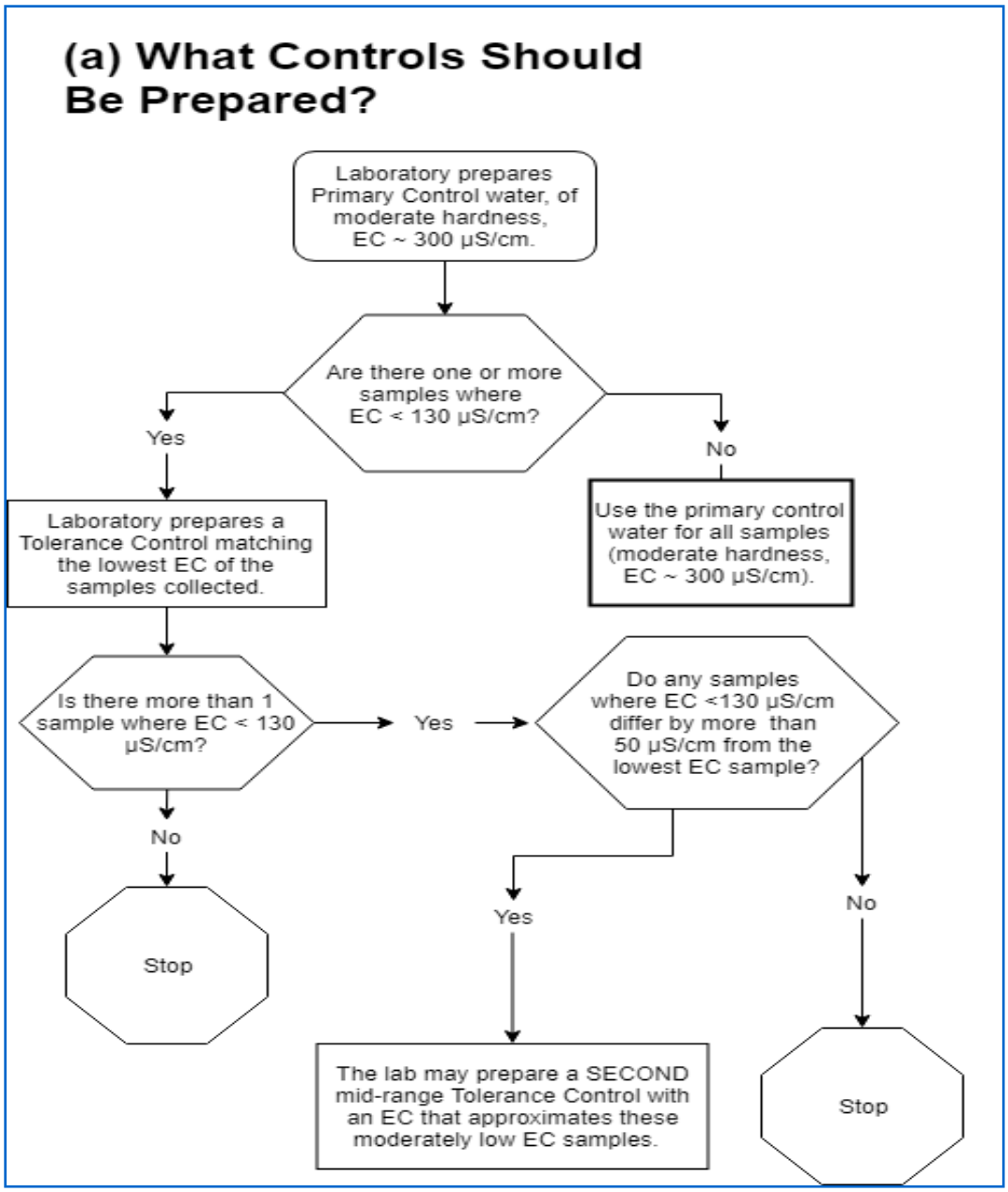
ITEM NO.			COMPONENT NAME	VERIFIED (NO	VERIFIED	FIXES NEEDED	NOT- APPLICABLE	COMMENTS
	10.3		If the specific conductance is > 2,500 µS/cm, *C. dubia* should not be tested. *H. azteca* can be used instead if samples are not already being tested for *H. azteca* toxicity.					

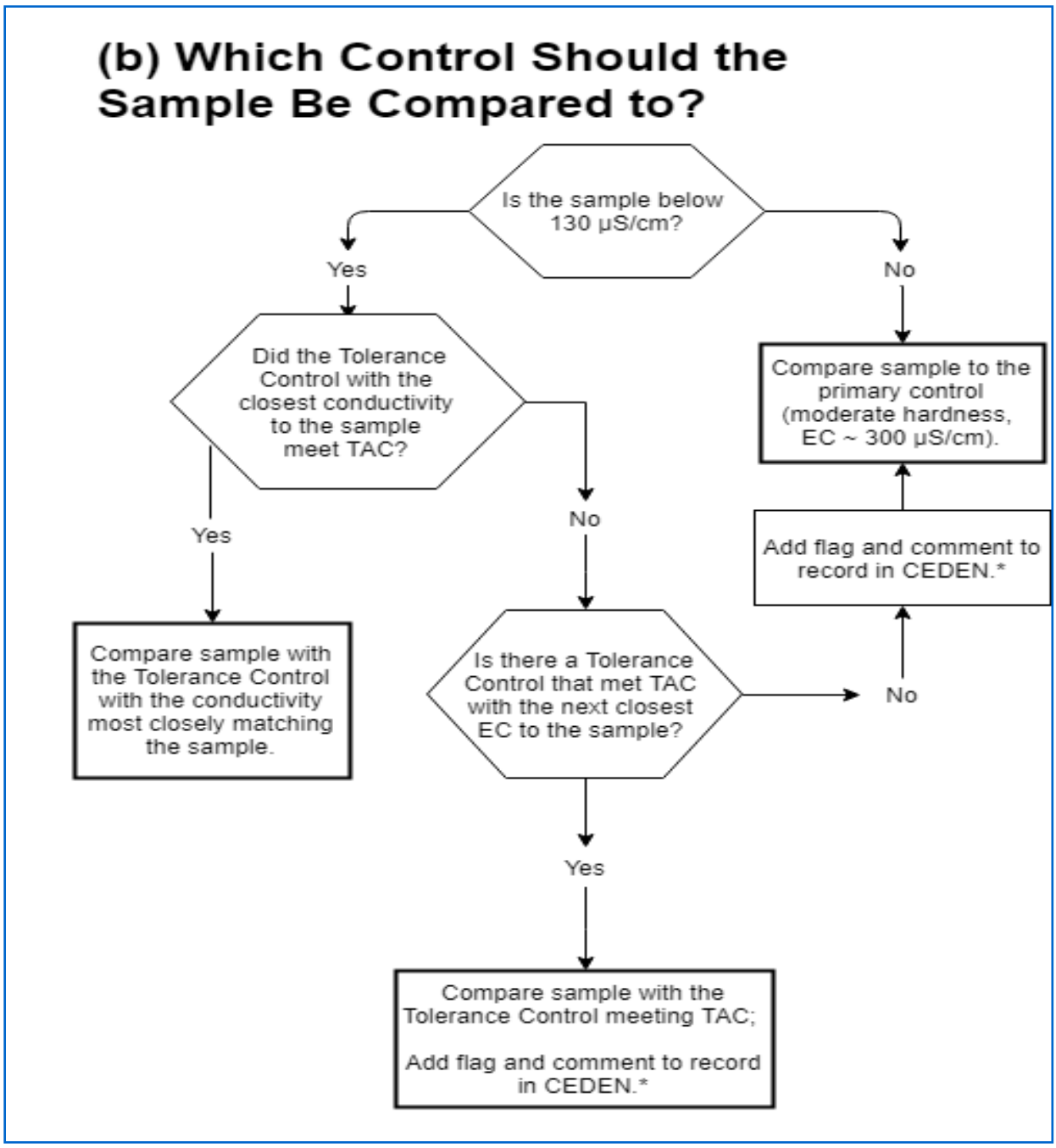
Salinity Controls

The Delta RMP performs toxicity testing and data management following SWAMP guidance and associated information. There are some specific situations when additional negative controls are performed, and associated data will need to be flagged either on the result and/or batch level.

CONTROL DECISION TREES

The following decision trees were developed by the Delta RMP Pesticide Subcommittee to provide guidance on when a tolerance control should be performed, what kind of tolerance control should be created, and which samples should be compared to which controls.





FLAGGING BUSINESS RULES

The following image reflects the scenarios and flagging combinations that have been discussed and agreed upon by the Delta RMP Pesticide Subcommittee; these will rules will be followed to ensure consistency in flagging and comments across years.

Table 12 is used to illustrate scenarios for combinations of passed and failed TAccC for CNEG and CNSL controls in a tox test batch. Batches with conductivity above tolerance range (requiring a CNSL high sample instead, or in addition) would be flagged similarly to the CNSL low cases.

The most notable is case 2, where the CNEG fails (-), but the CNSL passes (+). Even though the CNSL passes and could hypothetically be used as a control for significance testing versus low conductivity samples, those tests for samples are deemed "R" "rejected" due to failure of the CNEG.

Another notable situation is case 3, where the CNEG passes, but the CNSL fails. The standard procedure is to use the CNEG as the control against which samples (even those outside of tolerance range) are compared, but there may be cases where the apparent toxic response and the CNSL failure are very similar.

Table 12. QACodes Applied to Control and Test Samples for Possible CNEG and CNSL pass/fail Combinations.

Case	CNEG	CNSL low	BatchVer Code	Batch ComplianceCode	Control used for samples in tolerance range	QACode on CNEG	QACode on samples in tolerance range	Control used for samples below tolerance range	QACode on CNSL	QACode on samples below tolerance range
1: CNEG+ CNSL+	pass TAccC	pass TAccC	VAC	Com	CNEG	None	None	CNSL low	TAC	TAC,TCI
2: CNEG- CNSL+	fail TAccC	pass TAccC	VAC,VCN	Rej	-- N/A	R	R	NA	R,TCF	R,TCI
3: ##CNEG + CNSL-	pass TAccC	fail TAccC	VAC,VMD	Qual (only applied to low conductivity samples and CNSL)	CNEG	None	None	CNEG	TCF	TCI
4: CNEG- CNSL-	fail TAccC	fail TAccC	VAC,VCN	Rej	-- N/A	R	R	NA	R,TCF	R,TCI

Batch Verification Code Scenarios

Toxicity batches are assigned batch verification codes based on the quality control of samples within the batch using CEDEN codes. There have been unique situations during the history of the Delta RMP where the batch verification code needs to reflect a minor deviation (VMD), a serious deviation (VSD), or rejection (VR). The following instances are example situations where these codes have been applied to date. The assignment of a batch verification code when deviations occur should be reported to the Delta RMP Technical Program Manager and the Pesticide TAC. This table may be added to or revised over time based on guidance from the Pesticide TAC and State Board.

Table 10. Examples of instances where the batch verification code reflects data with minor deviations, serious deviations, or are rejected.

Instance: Samples outside of organism tolerance range, CNSL either not run or fails TAccC, statistical tests (for low or high conductivity samples) run against CNEG instead
BatchVerification Code: VSD (serious deviation)
Rationale: With the absence of a CNSL similar to low or high conductivity samples, whether any apparent toxic effect (for those samples out of tolerance range) is entirely or partly due to that parameter is unknown; for test batches where the CNSL is run but fails TAccC, the failure of the CNSL itself may indicate the influence of being outside of the tolerance range, and any apparent toxicity may include that confounding factor. VSD is to caveat potential data users that the deviations may not be "minor", which may be misinterpreted as equivalent to having "insignificant" effect.
Date added: 2021/03/09
Instance: Test condition "recommended" ranges deviations within 2x of the accepted range (e.g., for temperature outside of 25 ± 1°C recommendation, but still within 25 ± 2°C)
BatchVerification Code: VMD (minor deviation)
Rationale: Many method recommendations include a margin of safety, or show negligible or smaller degrees of effect where deviations are only slightly beyond target ranges. This table may be edited or refined for parameters with sharper cutoffs where notable effects are observed with smaller deviations outside of the range.
Date Added: 2021/03/09
Instance: Test condition "recommended" ranges deviations well outside of the accepted range (e.g., for 25 ± 1°C recommendation, may be outside of 25 ± 2°C)
BatchVerification Code: VSD (serious deviation)
Rationale: Deviations well outside of a recommended range have a higher probability of exceeding any margin of safety built into a method, and may show effects. VSD is to qualify data deviations may not be "minor", t. If there are parameters that are identified as being less sensitive to deviations, specific exceptions or handling rules for those may be added at a later date.
Date Added: 2021/03/09
Instance: Test condition "REQUIRED" are not met
BatchVerification Code: VR (rejected)
Rationale: Deviations outside of method "requirements" are presumed to be extremely serious, sufficient to warrant rejection of data in most cases. This table may be edited or refined for parameters where notable effects are not expected or observed, in cases rejection might be too extreme, and would otherwise remove data that might be useful for more limited purposes (e.g., if a VSD were applied instead).
Date Added: 2021/03/09
Instance:
BatchVerification Code:
Rationale:
Date Added:

ATTACHMENT C. MLJ ENVIRONMENTAL TISSUE ANALYSIS REVIEW CHECKLIST

MLJ Tissue Analysis Checklist

Item No.		Component Name	Verified (No	Verified	Fixes Needed	Not Applicable	Comments
1		Fish Composite Check (If applicable)					
1.1		Sample and Collection Verification					
	1.1.1	Lab Sample Details: Compare sample collection information from the database to the EDD to verify they are the same.					
1.2		Organism Checks					
	1.2.1	TisSource = NA					
	1.2.2	OrganismID is in a consistent format.					
	1.2.3	Fork Length < Total Length.					
	1.2.4	Project Specific: Check that the difference between the smallest fish length compared to the largest fish length is not more than 20%.					
	1.2.5	Review for outliers: fork length, total length and weight of fish.					
1.3		Tissue Checks					
	1.3.1	TissueID consistent format.					
	1.3.2	Project Specific: TissueName = fillet, PartsPrepPreservationName = Skin off					
	1.3.3	Review for outliers: tissue weight and weight of fish. Create a pivot table to review that the tissue weights are each less than the fish weights (or that they are similar values if using the whole fish).					
1.4		Composite Checks					
	1.4.1	Check the CompositeID is in a consistent format. CompositeIDs should usually include the StationCode, SampleDate and Organism reference. If program has individual vs composite samples typically “I” or “C” are referenced in the CompositeID.					
	1.4.2	Check that the CompositeType, CompositeReplicate, CompositeWeight, UnitCompositeWeight, HomogDate, OrganismGroup, ComAgencyCode are the same for each CompositeID.					
	1.4.3	Review for outliers: use the pivot table to check the individual organism weights against the CompositeWeight.					
2		Bivalve Composite Check (If applicable)					
2.1		Sample and Collection Verification					
	2.1.1	Lab Sample Details: Compare sample collection information from the database to the EDD to verify they are the same.					
2.2		Organism Checks					
	2.2.1	TisSource = “Resident” or “Transplant”					
	2.2.2	OrganismID is in a consistent format.					
	2.2.3	Check that individual bivalve measurements are provided (unless the QAPP specifically allows average measurements).					
	2.2.4	Review for outliers: use the pivot table to check for consistent values for ShellLength, ShellWidth and LengthWidthType					

ITEM NO.			COMPONENT NAME	VERIFIED (NO	VERIFIED	FIXES NEEDED	NOT APPLICABLE	COMMENTS
	2.3		Tissue Checks					
		2.3.1	TissueIDs are in a consistent format.					
		2.3.2	Project Specific: TissueName = soft tissue without gonads, PartsPrepPreservationName = None					
		2.3.3	Review for outliers: use the pivot table to check tissue weight against organism weight (if reported).					
	2.4		Composite Checks					
		2.4.1	Check the CompositeID is in a consistent format. CompositeIDs should usually include the StationCode, SampleDate and Organism reference. If program has individual vs composite samples typically "I" or "C" are referenced in the CompositeID.					
		2.4.2	Check the CompositeType, CompositeReplicate, CompositeWeight, UnitCompositeWeight, HomogDate, OrganismGroup, ComAgencyCode are the same for each CompositeID.					
		2.4.3	Review for outliers: use the pivot table to check the individual organism weights against the CompositeWeight.					
3			Super Composite Check (If applicable)					
	3.1		Composite Checks					
		3.1.1	CompositeSourceID matches ID from original composite worksheet					
		3.1.2	SuperCompositeID is in a consistent format.					
		3.1.3	Check the CompositeType, CompositeReplicate, CompositeWeight and UnitCompositeWeight are the same for each SuperCompositeID					
		3.1.4	CompositeType = super					
4			Results Check					
	4.1		Verify Results with the PDF					
		4.1.1	Check 10% of the results. Filter on the sample information to ensure that the sample information lines up with the results. If the 10% check is all correct, then proceed with processing the EDD. If errors are found, check all results against the PDF.					
		4.1.2	Check the case narrative in each PDF for important information about reanalysis, hold time violations, or anything that appears out of the ordinary that could affect specific samples or the entire batch. Paste snips of pertinent information into the LaboratoryQuestions tab, and update LabResultsComments if necessary.					
		4.1.3	Check the CompositeID matches corresponding composite worksheet CompositeID.					
		4.1.4	OrganismGroup = correct composite grouping.					
5			Sample Information					
	5.1		Coalition Samples (Grab, field duplicates, field blanks, matrix spikes)					
		5.1.1	SampleTypeCode = Composite (for normal samples)					

ITEM NO.			COMPONENT NAME	VERIFIED (NO	VERIFIED	FIXES NEEDED	NOT APPLICABLE	COMMENTS
6			Processing and Analysis Information					
	6.1		Lab Batches					
		6.1.1	Batch names should conform to the CV RDC batch naming guidelines, stored here: X:\P_CV_RDC\Management_Documentation\2_Documentation_EntryManuals\File-BatchName (or online at CV RDC batch naming conventions).					
		6.1.2	Batches are defined by Method. Each batch should have same Units (excluding surrogates) and Analysis Date. Analysis Dates in a batch should be within 24 hours of each other; if there is a Digest Date then digests/extractions should all be within 24 hours.					
	6.2		Method Name, Analyte Name, Fraction Name, Unit, MDL and RL					
		6.2.1	Each method, analyte, fraction and unit has correct Preparation & Digestion. Review eQAPP to verify.					
	6.3		ExpectedValue					
		6.3.1	All MS, LCS, CRM or Surrogate samples have an expected value.					
	6.4		LabSampleComments					
		6.4.1	LabReplicates of 2 should have an RPD (Relative Percent Difference) recorded (excluding surrogate samples).					
		6.4.2	All LCS and MS have a PR (Percent Recovery) recorded					
		6.4.3	Check the correct format for PR and RPD was applied: use “PR XX” or “RPD XX”; when in combination (such as for an MSD), use “PR XX, RPD XX” (e.g., PR 99, RPD 5)					
	6.5		Submitting Agency					
		6.5.1	Submitting Agency is MLJ Environmental					
	6.6		BatchVerificationCode					
		6.6.1	Populate BatchVerificationCode column with VAC if all checks in this checklist are performed.					
7			QA Checks					
	7.1		Batch Amount Check: Verify laboratory batches have the correct amount of QC required by the QAPP; if QC is missing batch is appropriately flagged with a LabSubmissionCode of QI and a lab batch comment is included. (Verify with lab first as to why it is missing)					
	7.2		Hold Time Check: Check extraction/analysis occurred within the appropriate holding times; if holding times were not met the batch is appropriately flagged and a lab batch comment is included.					

ITEM NO.			COMPONENT NAME	VERIFIED (NO	VERIFIED	FIXES NEEDED	NOT APPLICABLE	COMMENTS
	7.3		Laboratory QC Check: Laboratory QC (MS, LCS, MSD, Lab Blank, Lab Duplicates) Verify samples are within the eQAPP requirements; if QC is outside of requirements the batch is appropriately flagged and a lab batch comment is included. Verify LabBlanks, Matrix Spikes, Lab duplicates and LCS's and any other specific MQO's according to eQAPP.					
	7.4		LabBatch Comments Check: Once all QACodes are applied use a pivot table to verify that LabBatch comments reflect all QACodes in the Results tab. (Make sure to refresh pivot table before check and use the Standardized LabBatchComments.) Check that all QC issues explained at beginning of report are recorded in EDD with either a QACode or in the batch comment. Standardized LabBatchComments excel file is located here: W:\P_ILRP\2.3_DataMgmt\6_ReviewEDDs\EDDChecking					
	7.5		Project Specific: Look at LabReplicates: if either lab results are ND, the RPD values should be NA. Change the value the lab has calculated to RPD NA if either rep 1 or rep 2 has a result of ND.					
	7.6		LabSubmissionCode Check: If the batch has any QACode other than "None", labbatch CANNOT be "A"; should be "A,MD" with a batch comment explaining the code; note that there is NO space between the "A," and "MD".					
	7.7		Lab Report qualifiers: double check PDF lab report and make sure any appropriate qualifiers are added to either the result or batch comments					
8			Unique Row Check					
	8.1		Unique Row: Verify that each row is unique. Sample and database unique.					
9			Data Checker					
	9.1		Data Checker: Run file through data checker and resolve any issues. http://checker.cv.mpsl.mlml.calstate.edu/CVRDC/CVRDCUpload.php. When errors are found run through data checker again until all applicable items are resolved. For CEDEN template use: http://ceden.org/CEDEN_checker/Checker/CEDENUpload.php					
	9.2		LabBatch naming convention changed. Verify less than 50 characters (max for the database). The data checker will show an error for anything over 35 characters, which is ok. No action necessary to change if under 50 characters.					
10			Tracking					
	10.1		Counts: Refresh pivot table for counting analytes for each environmental sample. Update analysis count in MIS ensure all analytes expected were received.					

ITEM NO.			COMPONENT NAME	VERIFIED (NO VERIFIED	FIXES NEEDED	NOT APPLICABLE	COMMENTS
	10.2		Tracking: Update MIS, LaboratoryDataProcessing group, qry2_ReportEDDProcessing with date EDD is complete and your name.					

Appendix B. Example Chain of Custody Form

AXYS CHAIN-OF-CUSTODY RECORD

Client Name:	MLJ Environmental
Address:	1480 Drew Ave #130, Davis, CA 95618
Sampled By:	
Phone:	(530) 756-5200
Fax:	(530) 756-5225
Project Manager:	Melissa Turner
Project Name:	Delta RMP CEC

	Sample Identification	Sample Date	Sample Time	Sample Matrix	Number	Type	Preservative	**PBDE 47** (SGS AXYS MLA-033 Rev 06)	**PBDE 99** (SGS AXYS MLA-033 Rev 06)	**PBDE suite** by Method SGS AXYS MLA-033 Rev 06	**Immediately freeze all samples to -20°C** SAMPLE COMMENTS
1				Sediment	2	8oz Amber Glass Jar	Ice	X	X	X	
2											
3											
4											
5											
6											
7											
8											

Comments:

Please fax signed and completed COC to MLJ Environmental:
(530) 756-5225, or email to
mbundock@mljenvironmental.com

Immediately freeze all samples to -20°C when received.

Relinquished By	**Relinquished By**
Signature	Signature
Print Name	Print Name
Organization	Organization
Date Time	Date Time
Received By	**Received By**
Signature	Signature
Print Name	Print Name
Organization	Organization
Date Time	Date Time
Temperature when received (°C):	Temperature when received (°C):

Appendix C. Sampling and Analysis Plan for Delta CEC Pilot Study

Sampling and Analysis Plan

Delta CECs Pilot Study

FY 2021/22

August 20, 2021

Submitted by:

APPLIED
marine
SCIENCES

4749 Bennett Drive, Suite L
Livermore, CA 94551
925-373-7142

1. Introduction

This Sampling and Analysis Plan (SAP) describes activities associated with implementation of the Delta Regional Monitoring Program (Delta RMP) Constituents of Emerging Concern (CEC) monitoring performed during the Fiscal Year 2021/2022 (FY 21/22). This covers sampling conducted for the water quality, sediment quality, and bioaccumulation components, which are each described in detail below. All sampling and analysis will be conducted under the dictates of the Delta RMP CECs Pilot Project Quality Assurance Project Plan (QAPP) [ASC in prep].

Several of the protocols contained herein rely largely on guidance provided by the California State Water Resources Control Board (2020) for monitoring environmental media for analysis of PFAS, a Delta RMP target and CEC analyte for which contamination by sampling process is a key concern. The intent of this protocol is to assist sampling personnel with collections of environmental media in a manner that will minimize any sampling-related effect upon analytical results to the maximum extent practical.

1.1. Objectives

The objectives of the sampling effort are to:

1. Collect water quality samples at up to 12 sites over four events, two wet season and two dry season for analysis of identified CECs. Sampling will incorporate a minimum of one replicate sample per event, representatively distributed across sampling personnel and sites.
2. Collect sediment quality samples at up to 3 sites for one dry season event for analysis of identified CECs. Sampling will incorporate one replicate sample per event.
3. Collect resident clam samples at up to 6 sites for one dry season event for analysis of identified CECs.

1.2. Personnel

The personnel and work assignments will be determined on an event-by-event basis from a pool of staff made available to the project from ICF, MLJ Environmental (MLJ), and Applied Marine Sciences, Inc. (AMS). Staff will be assigned based upon personnel availability and qualifications.

1.3. Sampling Event Selection

Dry season sampling events will be scheduled in coordination with Agency personnel, laboratories, and participating Project staff to occur during the typical California dry season (July through October). In the case of off-season precipitation, all dry season sampling will incorporate a minimum of 48-hrs antecedent dry weather. Additional detail on sampling event selection is provided in the sections that follow.

Wet season sampling events for water quality collections will be scheduled based upon presenting weather and requirements identified for storm event selection. More detail on storm criteria are presented in the water quality sampling section below.

2. General Sampling Guidelines

The sampling list included for CEC analysis (Table 1) incorporates monitoring for a variety of analytes with historic uses as hormones, plasticizers, pharmaceuticals and personal care products (PPCPs), flame retardants, and non-stick coatings. Sampling protocols for this effort have been designed to minimize influence of sampling operations upon monitoring results, with precautions incorporated to address influence associated with analytes most likely to be contaminated through typical monitoring operations:

- Bisphenol-A - used primarily in the production of polycarbonate plastics and epoxy resins.
- PFAS - used in a variety of industrial, commercial, and consumer products, including materials used for environmental monitoring. Some of these products could be present and/or used during a routine sampling event, such as plastic bags and bottles, waterproof clothing, detergents, and waterproof pens and paper.

Table 1. Analyte List for Delta RMP CECs Monitoring for Water, Sediment, and Tissue Samples

Matrix	Lab	Analyte	Component Analytes
Tissue (clam)	SGS-Axys	PBDEs	PBDE 047, 099, Moisture, Lipid
Water	Vista	Galaxolide	Galaxolide
Water	Weck	Hormones	Estrone, Estradiol
Water	Weck	Pharmaceuticals	Ibuprofen, Diclofenac, Triclosan, BisphenolA
Water	Weck	TSS	Suspended Solids
Water	Vista	PFAS	PFOS, PFOA
Sediment	SGS-Axys	PBDE	PBDE 047, 099, Moisture
Sediment	SGS-Axys	PFAS	PFOS, PFOA, Moisture
Sediment	Weck	TOC	TOC

The uses of products containing the above compounds could possibly contaminate the samples during sample collection (including preparing the sampling site, actual sample collection, decontamination, and shipment) and therefore should be avoided to the extent practicable through all phases of the sampling and sample handling operation. Due to the nature of anticipated sampling operations, especially when normal sampling operations may be required to be modified associated with functioning in a Covid-19 affected environment, some influence may be unavoidable. The following guidelines will, however, help minimize any potential influence of sampling operation.

2.1. Sampling Operations Set-up

The prospective sampling site should be evaluated prior to sampling to identify potential contamination risks and to select dedicated eating, staging, and sampling areas[1]:

- Eating Area: Given the duration of expected sampling days, some allowance must be made for sampling personnel eating and drinking. If an eating area is to be used, it must be separate from the sampling and staging areas, and must be the only place where food and drink are stored and consumed. Food packaging must not be in the sampling and staging areas during sampling due to the potential for PFAS cross-contamination.

[1] Given the nature of this sampling using vessels and vehicles and sometimes difficult access conditions, idea working conditions may need to be adjusted, but attempts should be made by sampling personnel to minimize sampling influence in all stages of sampling.

- Staging Area: The staging area is where equipment is set-up and personal protective equipment is put on and taken off. As employed, PFAS-free over-boots and PPE (such as nitrile gloves) should be put on in the staging area prior to sampling activities.
- Sampling Area: Sampling areas are the areas of the field where samples are collected. When staff require a break to eat or drink, they should move to a staging area before removing gloves, coveralls, and any other appropriate PPE, if worn. When finished, staff should wash their hands and put on a fresh pair of powderless nitrile gloves and appropriate PPE at the staging area before returning to the sampling area.

Consistent with CSWRCB (2020), sampling materials and field supplies are divided into three groups that indicate their potential usage associated with monitoring:

- Allowable materials: These materials are unlikely to be sources of cross contamination and can be used during all sampling stages in the immediate sampling environment.
- Staging area-only materials: These materials may contain potential sources of contamination and should not come into direct contact with the sample but can be used in the staging area away from sample bottles and equipment. Care should be taken to thoroughly wash / sanitize hands and don new gloves after handling any of these materials.
- Prohibited materials: These include items that are well-documented to contain contaminating materials and may present a threat to the integrity of the sample.

2.2. Personal Protective Equipment (PPE)

The following materials are / are not allowed for specific uses associated with Delta RMP monitoring:

Table 2. Allowable / Unallowable PPE for Delta RMP CECs Monitoring

Allowable Materials	Staging Area Materials	Prohibited Materials
• Synthetic or 100% cotton clothing that has been well-laundered (without use of fabric softener) • Waterproof clothing made with polyurethane, PVC, wax-coated fabrics, rubber, or neoprene • Boots made of polyurethane and/or PVC • Polypropylene shoe / boot covers[1] • Powderless nitrile gloves	• First-aid adhesive wrappers Note: Hands should be washed and gloves changed after handling these products.	• "Chemical" sunscreens • Scented personal care products • Antibacterial soaps and sanitizers containing Triclosan / Triclocarban (most sanitizers have removed these compounds, but confirm on ingredient list) • Water/stain/dirt-resistant treated clothes (including but not limited to Gore-Tex™, Scotchgard™, and RUCO®) • New unwashed clothing • Clothes recently washed with fabric softeners • Clothes chemically treated for insect resistance and ultraviolet protection • Coated Tyvek® • Latex gloves

Notes:

[1] For example, https://www.thomassci.com/nav/cat2/apparel_shoebootcovers/0.

There are many often-used and industry standard PPE items that may be required to be used during sampling events that have not been completely evaluated, including hard hats and safety glasses. If use of these items is required, they will be accounted for through use of field blanks associated with aqueous sample collection.

2.3. Sun and Biological Protection

Because biological hazards (sunburn, mosquitos, ticks, etc.) may be encountered during some types of sampling, the elimination of specific clothing materials or PPE (sunscreens and insect repellants) could pose a health and safety hazard to staff. The safety of staff should not be compromised by fear of potentially contaminating materials without any scientific basis. Personal safety is paramount. Any deviation from this guidance, including those necessary to ensure the health and safety of field staff, should be recorded in field notes and discussed in the field reports.

Prolonged sun exposure will require sun protective gear such as hats and long shirts and/or sunscreens. The latter may include PFAS and/or fragrances in their manufacture. Protection against insects may require the use of insect repellant. The words “natural” and/or “organic” in a product name or used to describe it does not mean that it is PFAS-free. A detailed list of sunscreens and insect repellants that have been analyzed and found to be PFAS-free is available from the Michigan Department of Environmental Quality (https://www.michigan.gov/documents/pfasresponse/PFAS_Sampling_Quick_Reference_Field_Guide_634603_7.pdf). Note that this is not a comprehensive list of allowable insect repellants or sunscreens; other products may meet the requirements for use. Listing or omission of any product does not imply endorsement or disapproval. Also, there is no guarantee that these products will always remain PFAS free.

If sunscreens or insect repellants are used during a PFAS sampling event, then the product should be applied in the staging area. Hands should be washed and new gloves used following application.

2.4. Personal Care Products

Many personal care products, including cosmetics, moisturizers, fragrances, and creams may contain PFAS or may become contaminated with PFAS from the containers they are supplied in. For this reason, the use of such products should be avoided or minimized on the day of sampling, and 24 hours prior to sampling. The words “natural” and/or “organic” in a product name or used to describe the product does not mean that the product is PFAS-free. More information is available from the Environmental Working Group’s Skin Deep Guidance (https://www.ewg.org/skindeep/contents/is-teflon-in-your-cosmetics/).

2.5. Food Packaging

PFAS are known to be prevalent in food packaging, including paper plates, food containers, bags, and wraps. Therefore, food and drink should be avoided during sampling. However, if food or water is required by sampling personnel, it should be kept out of sampling and staging areas. Sampling staff should carefully remove and store sampling equipment prior to obtaining food, wash hands / sanitize before and after consuming food, and replace sampling PPE (including donning new nitrile gloves) before continuing with sampling.

3. Sampling Procedures

3.1. Water Quality Sampling

Water samples will be collected at 12 sampling locations (Table 3) during 4 events per year: 2 dry weather events and 2 precipitation events. Water samples will be analyzed for the constituents identified in Table 3.

Table 3. Target Sampling Locations for Delta RMP CECs Water Quality Collections

Station Code	Station Name	Latitude	Longitude	Notes
519SUT108	Sacramento River at Elkhorn Boat Launch Facility	38.67245	-121.625	Elkhorn Boat Launch Facility, 5827 Garden Hwy, Sacramento, CA 95837
510ST1301	Sacramento River at Freeport	38.45555	-121.50194	
510SACC3A	Sacramento River at Hood Monitoring Station Platform	38.36771	-121.5205	
519AMNDVY	American River at Discovery Park	38.60094	-121.5055	
541SJC501	San Joaquin River at Airport Way near Vernalis	37.67556	-121.26417	Year 1 DWR sampled from the platform at River Club; Year 2 may be at bridge.
544LSAC13	San Joaquin River at Buckley Cove	37.971833	-121.373619	
519DRYCRK	Dry Creek at Roseville WWTP	38.734098	-121.31444	ring the gate to be let in (6:30am or after); call Dan at WWTP for timing and to enter, office: 916-746-1872, cell: 916-955-6631
511SOL011	Old Alamo Creek at Lewis Road	38.34643	-121.89684	Call Bill Lozano (brother of property owner) to let him know that you will be accessing their property. Best place to park is just north of creek in the big lot 707-580-3905 I; 707-447-1666 (h); sample creek, not irrigation channel
POTW 1	POTW Source No. 1	38.73390	-121.31505	
POTW 2	POTW Source No. 2	38.34662	-121.90160	
SAC_UR3	Sacramento Urban Runoff (UR3)	38.60127	-121.49296	
Roseville UR1	Roseville Urban Runoff	38.80477	-121.32733	

This study's objective of wet-weather sampling is to characterize the influence of urban runoff. The strategy is to best capture the rising limb, or near the peak of the hydrograph, in safe conditions, while allowing for reasonable mobilization times and acknowledging geographic spread of sampling sites. This project intends to sample two wet-weather events:

1. First flush (likely Oct - Dec 2021)
2. Spring storm (Feb, Mar, or April 2022)

The target sampling triggers for the two precipitation events are provided in Table 4. These triggers apply for all water monitoring locations, including the large riverine sites and smaller tributaries.

Table 4. Precipitation Triggers for Two Wet Season Water Quality Sampling Events.

Event	Forecast Precipitation in 24 hours over basin[1]	Minimum Probability 48 hours prior to event	Notes
First flush	0.5”	50%	Target: Oct – Dec
Spring storm	0.25”	75%	Target: February, March, or April

Notes
[1]Basin precipitation to be estimated based on NWS forecasts for Sacramento and Stockton

Project staff will make the decision on when to sample stormwater using two National Weather Service (NWS) locations and the California Nevada River Forecast Center:

- Sacramento: https://forecast.weather.gov/MapClick.php?lat=38.579440000000034&lon=-121.49084999999997#.YRLKydNKjzd
- Stockton: https://forecast.weather.gov/MapClick.php?lat=37.96&lon=-121.29#.YRLLLNNKjzc
- CNRFC: https://www.cnrfc.noaa.gov/

It is desirable to capture the “rising limb” of the hydrograph, the period during which discharge is increasing due to rainfall-induced runoff. In making the “go/no-go” decision for whether to monitor a storm, project staff will also consult guidance plots at appropriate discharge sites or recorded discharge at upstream flow stations (in making the decision to mobilize, the recorded discharge at upstream flow stations shall show an approximately 2-3X increase in flows). The timing of actual sampling shall take streamflow peak travel time into consideration. Guidance plots developed by the California Department of Water Resources (DWR) (https://cdec.water.ca.gov/guidance_plots/) show forecast river flow and stage, and are available for dozens of river reaches in the Central Valley.

Samples may be collected during the day or night but are preferable for daytime collection for safety reasons. If crews are not able to sample at night, sampling shall be done as early as practical. By preference, sampling shall occur no more than 12 hours after the last hour with rainfall totals of less than 0.1 inch over the target area.

Water quality sampling procedures will be adjusted depending on the platform (i.e., vessel vs. land) and general sampling conditions (e.g., safe access for direct immersion or not). Guidelines for various aspects of sampling collection and handling are described below. Example field datasheets for water quality sampling are included within Appendix A.

3.1.1.Sample Collection Equipment

A list of sampling equipment for water quality operations is provided in Table 5. Samples will be collected by direct immersion when possible (i.e., when sample containers are not pre-loaded with preservative). When preservative is pre-loaded, then samples will be collected by use of a transfer container that is pre-cleaned and of the same material as the sampling container, but does not contain preservative.

Table 5. Equipment Mobilization List for Delta RMP CECs Water Quality Sampling

Description of Equipment	Material (if applicable)
Pole sampler	Stainless steel
Distilled water (1 gallon)	
Water quality meter (pH, DO, specific conductance, temp, turbidity)	Calibrated within 24 hrs of collection
Bailer	
Sample containers	
Headlamps / flashlights	
Container for storage of sampling derived waste, dry	
Container for storage of sampling derived waste, wet	
Wet ice / blue ice	
Coolers	
Protective packaging materials	Bubble / foam bags
Splash proof eye protection	
PPE for sampling personnel, including traffic 8gmt. as required	
First aid kit	
Waders	
PFDs	
Nitrile gloves for sample collection, reagent handling	Nitrile
Field datasheets	
COC forms	
Shipping materials (as required)	
GPS	
Ballpoint pens	

3.1.2. Sample Sequencing

Before sampling begins, a sampling sequence should be established. Any water samples required at a particular site will be collected prior to conduct of any other monitoring components. To prevent cross-contamination, sampling personnel should collect samples in order of samples most likely to be influenced by sampling operation (e.g., PFAS, PPCPs) to least likely (pharmaceuticals, TSS).

3.1.3. Sample Collection and Storage

Samples shall be collected, when possible, mid-stream. Samples shall be collected 0.5 m below the surface, or closer to the surface at mid-depth in shallow tributaries if the water depth is less than 1 m. For wade-in locations, the crew members will collect sample water upstream of where they are standing to minimize influence of sampler upon samples.

All bottles should be prepared in field kits compiled for each sampling site. For all environmental media, hands should be well-washed before sampling. Clean powderless nitrile gloves must be put on before collecting samples, handling sample containers, and handling sampling equipment. The sample container must be kept sealed and only opened during the sample collection. The sampling container cap or lid should never be placed the ground, or on any other surface.

The following additional considerations should be taken during sample collection to prevent contamination:

- Regular/thick size markers (Sharpie® or otherwise) are to be avoided; as they may contain PFAS.
- Do not use sticky notes (e.g. Post-it Notes®), plastic clipboards, or waterproof paper and notebooks in the sampling area.

- Fine and Ultra-Fine point Sharpie® markers are acceptable to label the empty sample bottle while in the staging area provided the lid is on the sample bottle and gloves are changed following sample bottle labeling.
- Ballpoint pens may be used when labeling sample containers. If ballpoint pens do not write on the sample container labels, preprinted labels from the laboratory may be used.
- Rite in the Rain® notebooks are acceptable to use in the staging area provided gloves are changed after note taking.
- Use HDPE or polypropylene sample bottles with Teflon®-free caps, provided by the laboratory.
- Chemical or blue ice should not be used *unless supplied directly by the analytical lab*.
- Samples and ice should be double-bagged using LDPE or HDPE bags. Care should be taken to ensure that bags and ice are kept in the staging area, do not come into direct contact with the sample media, and gloves are changed after handling.
- Samples must be chilled during storage and shipment and must not exceed 50°F (10°C) during the first 48 hours after collection.

3.1.4. Decontamination

For non-dedicated sampling equipment (e.g., stainless steel extension pole), the following materials and procedures must be used for decontamination:

- Use of laboratory supplied blank water is preferred for cleaning and decontamination, but commercially available deionized water may be used for cleaning and decontamination if lab water is unavailable.
- Municipal drinking water may be used for cleaning or decontamination if the water is known to be PFAS-free.
- Do not use Decon 90®
- Alconox®, Liquinox®, and Citranox® can be used for equipment cleaning and decontamination.
- Sampling equipment can be scrubbed using a polyethylene or Polyvinyl chloride (PVC) brush to remove particulates.

Sampling equipment is first washed with a Liquinox (or similar) and blank water / deionized (DI) water solution by rinsing with the solution, agitating with a horse hair brush, and flushing with blank / DI water to fully remove cleaning solution. Personnel next perform a rinse with reagent-grade methanol, followed by another blank water / DI rinse. Personnel then rinse the equipment with site water 2 to 3 times before sample collection.

3.1.5. Sample Collection – Aqueous Samples

Containers to be filled as part of water sampling operations are identified in Table 6.

Table 6. Containers and Handing Requirements for Delta RMP CECs Water Quality Monitoring

Analysis	Container	Handling Requirements
Galaxolide	2 x 1.0 L amber glass	store at <6°C
Hormones	2 x 250 mL amber glass	Preserve with sodium azide (200 mg) and Ascorbic acid (100 mg); store at <6°C
Pharmaceuticals	2 x 250 mL amber glass	Preserve with sodium azide (200 mg) and Ascorbic acid (100 mg); store at <6°C
SSC	1.0 L polycarbonate bottle	<6°C
PFAS	250 mL HDPE or polypropylene bottle	<10°C

Water quality sampling will require a minimum of two persons. Sampling personnel will follow the previous guidelines for PPE, staging, selection of equipment, and decontamination procedures. For actual sample collection, sampling personnel will employ the following steps:

1. Don PPE equipment, including clean, powder-free nitrile gloves, in staging area.
2. Select appropriate sample container and pre-label with ballpoint pen in staging area.
3. Proceed to sampling area.
4. Open sample container and fill bottle according to laboratory instructions from a water depth of approx. 0.5 m and as close to center of channel as possible:
    a. Bottles without preservative – rinse 3 times with site water, then fill.
    b. Bottles with preservative – rinse transfer container 3 times with site water, then use to fill sample container, taking care not to overfill and lose preservative.
5. Close container and seal tightly.
6. Place sample container in provided zip-top bags (as available).
7. Surround sample containers with double-bagged (zip-top type) wet ice or laboratory-supplied blue ice.
8. Return samples to identified delivery spot after completion of the sampling day.

Collect field measurements in a manner that does not interfere with other sampling conducted at the station. Record measurements for the following parameters on field datasheets:

- Oxygen, Dissolved in mg/L
- Oxygen, Dissolved as % saturation
- pH
- Specific Conductivity in µS/cm
- Temperature, °C
- Turbidity as FNU or NTU

3.1.6. Field Quality Control Samples – Aqueous Samples

Field Blanks. Field blanks are required at a rate identified in the QAPP (i.e., minimum of 5% of total analyses in a given year distributed across sampling personnel and sites). Their collection entails the following:

1. Pre-label field sample containers and field blank containers with ballpoint pen in staging area.
2. At the field sample location, sampling personnel will open both the bottle containing laboratory blank water and the empty field blank container.

3. Sampling personnel will pour the contents of the blank water into the field blank container according to laboratory instructions.
4. Close container and seal tightly.
5. Place sample container in provided zip-top bags.
6. Surround sample containers with double-bagged (zip-top type) wet ice.
7. Sampling personnel will next collect the field sample as described above.

Field Duplicates. Field duplicates are required at a rate identified in the QAPP (i.e., minimum of 5% of total analyses in a given year, distributed across sampling personnel and sites). Field duplicates will be submitted blind to the analytical laboratory; it is important to note on the field datasheet the station at which the replicate was generated and provide a sample time of 10 to 15 minutes distant from the associated field sample. Their collection entails the following:

1. Pre-label field sample containers and field duplicate containers with ballpoint pen in staging area.
2. At the field sample location, sampling personnel will collect a duplicate sample immediately following collection of the replicate 1 sample.
3. Close container and seal tightly.
4. Place sample container in provided zip-top bags.
5. Surround sample containers with double-bagged (zip-top type) wet ice.

3.2. Sediment Sampling

Sediment samples will be collected at 3 sampling locations (Table 7) during 1 dry season event annually. Any required water quality samples will be collected prior to collection of sediment samples.

Table 7. Target Sampling Locations for Delta RMP CECs Sediment Quality Collections

Station Code	Station Name	Latitude	Longitude	Notes
519AMNDVY	American River at Discovery Park	38.60094	-121.5055	
519DRYCRK	Dry Creek at Roseville WWTP	38.734098	-121.31444	
511SOL011	Old Alamo Creek at Lewis Road	38.34643	-121.89684	

Sampling equipment to be mobilized for sediment sampling is identified in Table 8. Example field datasheets for sediment sampling are included within Appendix B.

Table 8. Equipment Mobilization List for Delta RMP CECs Sediment Sampling

Equipment	Comments
Sample scoops	Stainless steel
Sample trowels	Stainless steel
Compositing bucket	Stainless steel
Ekman grab sampler	Stainless steel
Water quality meter (pH, DO, specific conductance, temp, turbidity)	Calibrated within 24 hrs of collection
Sample containers (with labels)	
Methanol, Reagent grade	Teflon squeeze bottle with refill
Hydrochloric acid, 1-2%, Reagent grade	Teflon squeeze bottle with refill
Liquinox detergent (diluted in Teflon squeeze bottle with refill)	Squeeze bottle with refill
Deionized / reverse osmosis water	
Plastic scrub brushes	
Container for storage of sampling derived waste, dry	
Container for storage of sampling derived waste, wet	
Wet ice	
Dry ice (for samples requiring immediate freezing)	
Coolers, as required	
Aluminum foil (heavy duty recommended)	
Protective packaging materials	Bubble / foam bags
Splash proof eye protection	
PPE for sampling personnel, including traffic mgmt as required	
Gloves for dry ice handling (as needed)	Cotton, leather, etc.
Gloves for sample collection, reagent handling	Nitrile
Field datasheets	
COC forms	
Shipping materials (as required)	
GPS	

3.2.1. Decontamination

Sampling personnel will, to the extent practicable, follow the previous guidelines for PPE and staging. Sample equipment decontamination procedures are as follows:

1. Soak equipment (fully immersed) for three days in a 0.5 % solution of lab-grade detergent such as Liquinox™ detergent and deionized water.
2. Rinse equipment three times with deionized water and let dry in a clean place.
3. Rinse equipment with a dilute (1 to 2%) solution of hydrochloric acid, followed by a rinse with methanol, followed by another set of three rinses with deionized water. All equipment is then allowed to dry in a clean place.
4. The cleaned grab and stainless steel scoops are wrapped in aluminum foil (dull side touching the equipment) until used in the field. All other equipment is stored in clean Ziploc™ bags (polyethylene) until used in the field.

Should field decontamination be required, the following procedures will be followed. Sampling equipment is first washed with a Liquinox (or similar) and blank water / deionized (DI) water solution by rinsing with the solution, agitating with a horse hair brush, and flushing with blank / DI water to fully remove sediment and cleaning solution. Personnel next perform a rinse with reagent-grade methanol, followed by another blank water / DI rinse.

3.2.2. Sample Collection – Sediment Samples

Sediment samples will be analyzed for the constituents identified in Table 9.

Table 9. Containers and Handing Requirements for Delta RMP CECs Sediment Monitoring

Analysis	Container	Handling Requirements
PFAS	4 oz HDPE jar, unlined.	Store at < -10°C
PBDEs	4 oz amber glass jar, Teflon lined.	Store at < -10°C
TOC	4 oz clear glass jar, Teflon lined.	Store at < 6°C

Sampling personnel will collect archive samples from each site to account for any loss that might occur in shipping and handling. For actual sample collection, sampling personnel will employ the following steps:

1. Don PPE equipment, including clean, powder-free nitrile gloves, in staging area.
2. Select appropriate sample container and pre-label with ballpoint pen in staging area.
3. Proceed to sampling area and identify depositional areas.
4. Open PFAS sample containers and fill by scooping directly from depositional areas into the container to 80% capacity using uncoated stainless steel scoops. Close sample containers and seal tightly.
5. Collect sediment into compositing bucket from the same depositional areas as sampled for PFAS.
6. Stir material to homogenize using a stainless steel scoop.
7. Open each remaining sampling container and fill to 80% capacity. Close sample container and seal tightly.
8. Double-bag sample containers using zip-top type bags.
9. Surround sample containers with double-bagged (zip-top type) wet ice.
10. Place samples in freezer within 18 hours of sample collection.

Collect water quality field measurements in a manner that does not interfere with other sampling conducted at the station. Record measurements for the following parameters on field datasheets:

- Oxygen, Dissolved in mg/L
- Oxygen, Dissolved as % saturation
- pH
- Specific Conductivity in µS/cm
- Temperature, °C
- Turbidity as FNU or NTU

3.2.3. Field Quality Control Samples – Sediment Samples

Field Blank Samples. Not required for sediment sampling.

Field Duplicate Samples. Field duplicates will be collected at one site annually and will be submitted blind to the analytical laboratory; it is important to note on the field datasheet the station at which the replicate was generated and provide a sample time of 10 to 15 minutes distant from the associated field sample. Field duplicate samples will be collected at sites exhibiting sufficient mass of available sediment to support replicate analyses, and will be aliquoted out of the same composite as the field samples; ideally, replicate samples for the same analysis will be filled successively. Recon operations may assist in identifying acceptable sites with sufficient material. Sample handling is as identified above for sediment samples.

3.3. Biota Sampling

Field personnel will be responsible for collection resident *Corbidula fluminea* (*C. fluminea*) at six monitoring locations (Table 10) in the dry season annually.

Table 10. Target Locations for Delta RMP CECs Clam Collections

Station Code	Station Name	Latitude	Longitude	Notes
519SUT108	Sacramento River at Elkhorn Boat Launch Facility	38.67245	-121.625	
519AMNDVY	American River at Discovery Park	38.60094	-121.5055	
510ST1301	Sacramento River at Freeport	38.45555	-121.50194	
510SACC3A	Sacramento River at Hood Monitoring Station Platform	38.36771	-121.5205	
544LSAC13	San Joaquin River at Buckley Cove	37.971833	-121.373619	
541SJC501	San Joaquin River at Airport Way near Vernalis	37.67556	-121.26417	

Example field datasheets for water quality sampling are included as Appendix A. Sampling equipment to be mobilized for biota sampling is identified in Table 11.

Table 11. Equipment Mobilization List for Delta RMP CECs Biota Sampling

Equipment	Provider / Comments
Boat and trailer	ICF
Water quality meter (pH, DO, specific conductance, temp, turbidity)	Calibrated within 24 hrs of collection
Life jackets	ICF/AMS
PPE (mask, foulies, boots)	ICF/AMS
Clam dredge (attached with floats and line)	ICF/AMS
Rakes, shovels, sieves	ICF/AMS
Clam sample containers / labels	SFEI
Calipers	AMS
Scale	AMS
Sieves	AMS
Forceps	AMS
GPS unit	AMS
YSI ProDSS	AMS
Calibration solutions	AMS
Field binder / SWAMP field data sheets	AMS
Coolers & dry ice	AMS
Metal buckets and bins	AMS
Gloves (work and sampling)	AMS
Misc. (Clipboard, Ziploc bags, Foil, Sharpies, duct tape, etc.)	AMS
Packing material (bubble wrap, shipping label)	AMS
Hat / Sunscreen	ICF/AMS
Container for storage of sampling derived waste, dry	AMS
Container for storage of sampling derived waste, wet	AMS

3.3.1. Decontamination

Due to a much lower risk of contamination from sampling process, decontamination for clam collection equipment is a much less rigorous process compared to that for water quality and sediment collections. The goal of the cleaning process is to remove any adhering material or clams potentially wedged within the grab accumulation points. Ideally, cleaning will occur before arrival at a given station. Steps to be followed include:

- Turning clam dredge upside down to allow clams to fall to vessel deck, where they can be removed and discarded.
- While inverted, rinse with a hose to remove clams, soil, vegetation, etc.
- Remove foil liners from sieves / metal bins used for sorting clams and dispose of.
- Rinse sieves / bins with site water.

3.3.2. Sample Collection – Clam Samples

Sample containers and handling requirements are summarized in Table 12.

Table 12. Sample Containers and Handing Requirements for Delta RMP CECs Biota Monitoring

Analysis	Container	Handling Requirements
PFOS / PFOA, PBDEs	Foil / Ziptop bag	Wrap each clam individually; freeze on dry ice upon collection in a single overwrap

Resident *C. fluminea* will be collected by a clam dredge towed behind a vessel. The dredge is made of stainless steel with a sacrificial metal rake head secured at its mouth. The dredge has skids on the bottom to allow it to skim across the seafloor and while the front-mounted rake digs into the sediment. A rigid stainless mesh cage collects bivalves after they are liberated from the sediment.

A crew of at least three persons is required. The vessel skipper is responsible for vessel operations and two deckhands are responsible for dredge deployment and recovery, and sample processing.

Before deployment, a small plastic float and line are attached to the tail end of the dredge to assist with recovery should it become lodged by an obstruction. Additional plastic floats may be secured to the dredge to keep it upright in the water column during descent to the bottom.

While the vessel is moving, the deckhands will deploy the dredge by hand. The skipper will proceed at low speed and against the current while the dredge is lowered in the water column and dragging along the seafloor. The vessel continues dredging operations until it leaves the target sampling area, encounters an obstruction or resistance, or has been collecting for a sufficient period of time to empty the cage's content. At this point, the skipper takes the vessel out of gear and the deckhands begin dredge retrieval.

As the dredge is brought to the surface, the deckhands will draw in the ropes attached to the dredge towards the vessel davit. If the cage is filled with sediment, deckhands may rinse the cage with deck hose to remove some of the mud. If no clams appear to have been collected, deckhands may empty the dredge and immediately re-deploy. If clams are present in the cage, a deckhand will retract the davit so that is positioned near the deck, where clams are then dumped into a pre-cleaned non-coated metal bucket. Note that due to the nature of chemical analysis to be performed on these samples, clams should not contact with plastic or Teflon surfaces during processing. Deckhands, wearing new nitrile lab gloves, will then sort through the dredged material to remove extraneous material and dead clams. Live clams are rinsed with deck water to remove adhered sediments and placed into a second pre-cleaned non-coated metal bucket for temporary storage.

The above process is repeated until a sufficient number of clams is collected to support all analyses. The target number of clams at each site for this study is a composite of a minimum of 20 *C. fluminea* clams comprised of roughly the same proportion of clams that is representative of the size distribution at the sample location. To assemble each composite sample, clams will be sorted into 5 mm size classes (10-15, 15-20, 20-25, 25-30, 30-35, 35 mm+) and high outliers (>35 mm) will be included. A random subsample shall be taken from each of the bins, with the number from each bin representative of the total sample. For example, if field crews collect 100 clams, and there are 20 clams (or 20% of the total) in the 10-15mm bin, then the crew shall randomly choose 4 clams from this bin (n = 20 x 0.2 = 4). The crew shall round up or down to the nearest whole number when choosing the number of clams to subsample from each bin, such that the total sample size is 20. The goal is to ensure that the distribution of clam sizes in the subsample is similar to that of the larger sample.

The minimum mass required to support all analyses is 12 g of wet tissue mass per composite (18 g for replicate sites). In order to generate the minimum desired mass, field staff will estimate wet tissue mass before generating the field composite and before discarding any clams from a site. Based upon results of 2020 monitoring, field staff should estimate tissue mass using the following estimates of mass for a given size range shown in Table 13.

Table 13. Estimated Clam Mass by Size Range

Size Range	Estimated Mass (g)
10 – 15 mm	0.1
15 – 20 mm	0.4
20 – 25 mm	1.5
25 – 30 mm	1.8
>30 mm	2

For sites where the estimated mass falls near or below the minimum requirements, field staff should use best professional judgment to increase the number of clams in the aliquot to a sufficient mass to satisfy laboratory requirements. This may include over-representing clams from larger bin sizes, including a much larger number of clams from the smaller bin sizes, or some combination. Decision making should be documented in field datasheets.

Collect field measurements in a manner that does not interfere with other sampling conducted at the station. Record water quality measurements for the following parameters on field datasheets:

- Oxygen, Dissolved in mg/L
- Oxygen, Dissolved as % saturation
- pH
- Specific Conductivity in µS/cm
- Temperature, °C
- Turbidity as FNU or NTU

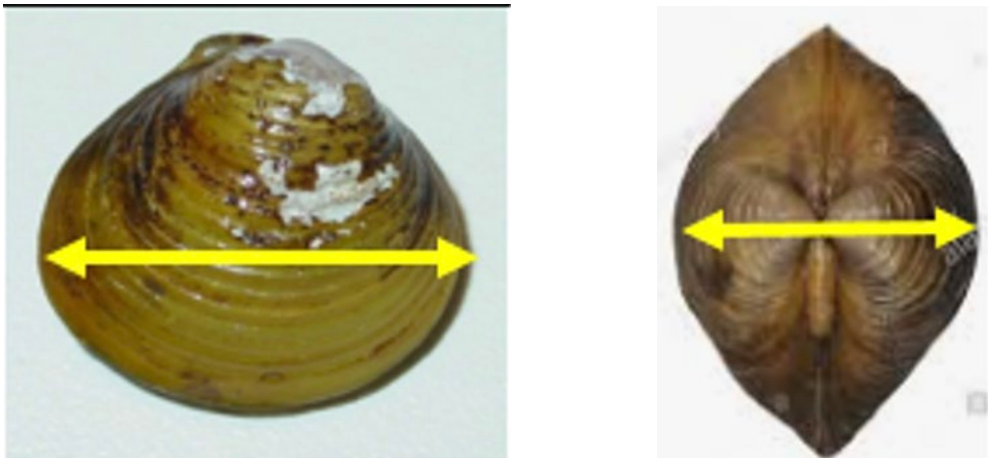


Figure 1. Measurement of Shell Length (left image) and width (right image).

3.3.3. Sample Handling

Ideally, field crews will measure and record the length, width, and weight of each clam to provide an estimate of the sampled clam biomass (Figure 1).[2] Each individual clam will then be wrapped in aluminum foil and transferred to a Ziploc bag for the site. Each bagged composite of clams will be labeled with project name, site code, sample date, and analysis. Ziploc bags are subsequently double-bagged and immediately transferred to a pre-cleaned cooler that is filled with dry ice for freezing. Unless otherwise noted, samples are kept frozen through delivery to the lab(s).

3.3.4. Field Quality Control Samples – Biota Samples

Field Blank Samples. Not required for biota sampling.

[2] It may not be feasible to measure all clams if size is skewed toward smaller end of bin ranges.

4. General Sample Handling Procedures

Non-frozen samples must be chilled during storage and shipment. Temperatures must not exceed 50°F (10°C) during the first 48 hours after collection. Samples may be stored on laboratory-supplied blue ice (verified as non-contaminating) or double-bagged wet ice stored in clean (i.e., unused) zip-top bags. Frozen samples should be frozen on dry ice in the field or transferred to laboratory freezers as soon as possible after sample collection.

Only laboratory-supplied blue ice or double-bagged wet ice should be used for storage or shipment of samples. When preparing samples for transportation or shipment, the samples and ice should be double-bagged using bags made of materials that do not present a PFAS contamination risk, such as HDPE or PP if possible.

At the conclusion of sampling events, sampling personnel will deliver all samples collected to MLJ at their 1480 Drew Ave, Ste 130, Davis, CA facility. Samples will be delivered under standard Chain of Custody procedures. MLJ personnel will coordinate with contract laboratories to store and ship samples.

4.1. Sample Labeling

The sample labeling system established by MLJ reduces the potential for mislabeling of samples in the field. Labels will be pre-populated with SampleID, laboratory, sample matrix, sample analyses, container type and container number (Figure 2). The sampler should complete:

- Sample date (mm/dd/yy),
- Sample time (24-hour time), and
- Sampler initials (Collected By).

The SampleID will consist of the CEDEN Station code followed by the type of sample being collected: [CEDEN StationCode] – [SampleType].

Sample type codes include the following:

- GR – grab samples
- GR2 – field duplicate for a grab sample
- IN – integrated samples (sediment)
- IN2 – field duplicate for an integrated sample
- CO – samples to be used for a composite (clam tissues)
- FB – field blank

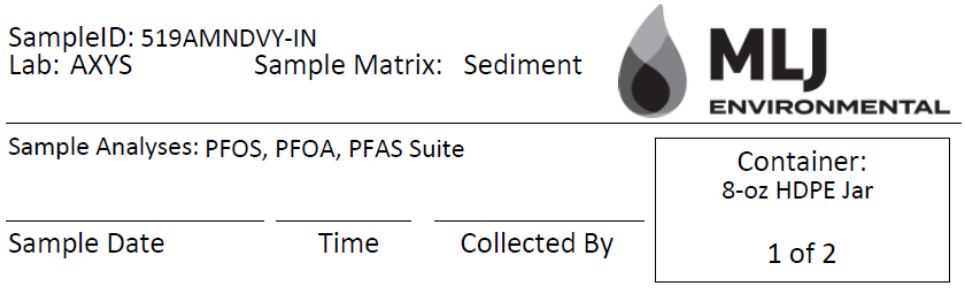


Figure 2. Example prepopulated sample label

4.2. Sample Chain-Of-Custody Forms and Custody Seals

All sample shipments for analyses will be accompanied by a chain-of-custody record (COC). COCs will be completed and sent with the samples for each laboratory and each shipment. If multiple coolers are sent to a single laboratory on a single day, multiple forms will be completed and sent with the samples for each cooler.

The COC will identify the contents of each shipment and maintain the custodial integrity of the samples. Generally, a sample is considered to be in someone's custody if it is either in someone's physical possession, in someone's view, locked up, or kept in a secured area that is restricted to authorized personnel. Until the samples are shipped, the custody of the samples will be the responsibility of the field contractor. The sampling team leader or designee will sign the COC in the "relinquished by" box and note date and time.

A self-adhesive custody seal will be placed across the lid of each sample at a point of closure. The shipping containers in which samples are stored (usually an ice chest or designated dry ice shipper) will be sealed with self-adhesive custody seals any time they are not in someone's possession or view before shipping. All custody seals will be signed and dated.

4.3. Shipping

Shipping shall be conducted via an approved courier using priority overnight delivery. General shipping protocols include:

1. For all bottles, ensure lids are tightly sealed. Apply enough bubble wrap around glass items to ensure that no hard edges can be felt through the bubble wrap. Bubbles shall be turned "in" toward the container. Ensure that there's ample bubble wrap on the lids as this can be an access point for breaking bottles. Place all bottles upright in the box or cooler (note: for larger glass bottles (1.0 L or bigger) preference is to ship in insulated styrofoam containers such as ColdIce), and fill in the remaining space with enough packing materials to ensure that they remain in place. Once complete, place the COC on top of the inside of the shipment within a closed zip-top bag.
2. Enter in the shipping information on the shipper's website to order a pick up and create shipping labels.
3. Place the shipping labels in the shipping envelope.
4. Place the fragile stickers (glass shipments only) and shipping labels on the package on all sides.
5. Review all shipments, make sure that COCs match the bottles in the shipment and the package is addressed to the correct lab.
6. Tape the boxes/coolers shut (including a signed custody seal below transparent shipping tape). For coolers, the lid shall be taped down in both directions (lengthwise over the handles and widthwise).
7. Coordinate with shipper for pickup / dropoff.

International shipping protocols will follow all requirements for import / export (for tissue samples) and will be coordinated with receiving laboratory.

4.4. Contacts

4.4.1. Laboratory Contacts

Questions during sample collection and handling process should be directed to the Project Manager. As required, laboratory contact information is shown in Table 14.

Table 14. Laboratory Contact Information for Delta RMP CECs Pilot Study.

Lab / Company / Agency	Contact	Phone	Email
SGS-Axys	Sean Campbell	250-655-5834	sean.campbell@sgs.com
Weck	Chris Samatmanakit	(626) 336-2139 ext 141	chris.samatmanakit@wecklabs.com
Vista	Katey Rein	(916) 673-1520	krein@vista-analytical.com
Physis	Mark Baker	714-602-5320 ext 204	markbaker@physislabs.com

4.4.2. Project Contacts

At the conclusion of sampling activities, all field teams should deliver samples to MLJ for distribution to appropriate laboratories. Following delivery, each field team should call / text the identified Event Coordinator to confirm safe completion of field activities or identify any safety-related or other issues of concern.

5. References

Aquatic Science Center, in prep. Quality Assurance Project Plan: Pilot Study of Constituents of Emerging Concern in the Sacramento-San Joaquin Delta.

California State Water Resources Control Board. 2020. Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines for Non-Drinking Water. September 2020.

6. Appendix A – Field Datasheets

SWAMP Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=WQ | Entered in d-base (initial/date) | Pg of Pgs

*StationID: _____ | *Date (mm/dd/yyyy): / / | *Group: | *Agency:

ArrivalTime: | DepartureTime: | *SampleTime (1st sample): | *Protocol:

*ProjectCode: 21DRMP5CEC | *Personnel: | *Purpose (circle applicable): WaterChem WaterTox Habitat FieldMeas | *PurposeFailure:

*Location: Bank Thalweg Midchannel OpenWater | *GPS/DGPS | Lat (dd.ddddd) | Long (ddd.ddddd) | OCCUPATION METHOD: Walk-in Bridge R/V _____ Other

GPS Device: | Target: | - | STARTING BANK (facing downstream): LB / RB / NA

Datum: NAD83 | Accuracy (ft / m): | *Actual: | - | Point of Sample (if Integrated, then -88 in dbase)

Habitat Observations (CollectionMethod = Habitat_generic)

WADEABILITY: Y / N / Unk | BEAUFORT SCALE (see attachment): | DISTANCE FROM BANK (m): | STREAM WIDTH (m): | WATER DEPTH (m):

SITE ODOR: None,Sulfides,Sewage,Petroleum,Smoke,Other_____

SKY CODE: Clear, Partly Cloudy, Overcast, Fog, Smoky, Hazy | WIND DIRECTION (from): (N / W / E / S)

HYDROMODIFICATION: None, Bridge, Pipes, ConcreteChannel, GradeControl, Culvert, AerialZipline, Other | LOCATION (to sample): US / DS / WI

OTHER PRESENCE: Vascular,Nonvascular,OilySheen,Foam,Trash,Other_____

DOMINANT SUBSTRATE: Bedrock, Concrete, Cobble, Boulder, Gravel, Sand, Mud, Unk, Other_____

PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode yyyy mm dd uniquecode): 1: (RB / LB / BB / US / DS / ##) | 2: (RB / LB / BB / US / DS / ##) | 3: (RB / LB / BB / US / DS / ##)

WATERCLARITY: Clear (see bottom), Cloudy (>4" vis), Murky (<4" vis) | PRECIPITATION: None, Fog, Drizzle, Rain, Snow

WATERODOR: None, Sulfides, Sewage, Petroleum, Mixed, Other_____ | PRECIPITATION (last 24 hrs): Unknown, <1", >1", None

WATERCOLOR: Colorless, Green, Yellow, Brown | EVIDENCE OF FIRES: No, <1 year, <5 years

OVERLAND RUNOFF (Last 24 hrs): none, light, moderate / heavy, unknown

OBSERVED FLOW: NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), 0.1-1cfs, 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs

Field Measurements (SampleType = FieldMeasure; Method = Field)

	DepthCollec (m)	Water Temp (°C)	pH	O_2 (mg/L)	O_2 (%)	Sp. Conduct. (uS/cm)	Salinity (ppt)	Turbidity (ntu)					
SUBSURF/MID/ BOTTOM/REP													
Instrument:													
Calib. Date:													

Samples Taken (# of containers filled) - Method=Water_Grab | **Field Dup YES / NO:** (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

SAMPLE TYPE: Grab / Integrated | COLLECTION DEVICE: | Indiv bottle (by hand, by pole, by bucket); Teflon tubing; Kemmer; Pole & Beaker; Other _____

	DepthCollec (m)	Galaxolide	Hormones	Pharma.	PFAS	TSS							
Sub/Surface													
Sub/Surface													

COMMENTS:

Modified 02/10/11

Figure 3. Field Datasheet, Water Quality Sampling

SWAMP Field Data Sheet (Sediment Chemistry) - EventType=WQ

Entered in d-base (initial/date) | Pg of Pgs

*StationID: _ _ _ _ _ _ _ _ _ _ _ _ | *Date (mm/dd/yyyy): / / | *Group: | *Agency:

ArrivalTime: | DepartureTime: | *SampleTime (1st sample): | *Protocol:

*ProjectCode: 21DRMP5CEC | *Personnel: | *Purpose (circle applicable): SedChem SedTox Habitat Benthic | *PurposeFailure:

*Location: Bank Thalweg Midchannel OpenWater | *GPS/DGPS | Lat (dd.ddddd) | Long (ddd.ddddd) | OCCUPATION METHOD: Walk-in Bridge R/V _____ Other

GPS Device: | Target: | - | STARTING BANK (facing downstream): LB / RB / NA

*Actual: | - | Point of Sample (if Integrated, then -88 in dbase)

Datum: NAD83 Accuracy (ft / m): | Same as Water/Probe Collection? YES NO | DISTANCE FROM BANK (m): | STREAM WIDTH (m):

WATER DEPTH (m):

Habitat Observations (CollectionMethod = Habitat_generic) ****Only complete Sed Observations (bolded) if WQ Observations are already recorded**

WADEABILITY: Y / N / Unk | BEAUFORT SCALE see Attachtment

HYDROMODIFICATION: None, Bridge, Pipes, ConcreteChannel, GradeControl, Culvert, AerialZipline, Other
LOCATION (to sample): US / DS / WI / NA

SITE ODOR: None,Sulfides,Sewage,Petroleum,Smoke,Other_____

SKY CODE: Clear, Partly Cloudy, Overcast, Fog, Smoky, Hazy | WIND DIRECTION (from): N W E S

OTHERPRESENCE: Vascular,Nonvascular,OilySheen,Foam,Trash,Other____

DOMINANTSUBSTRATE: Bedrock, Concrete, Cobble, Boulder, Gravel, Sand, Mud, Unk, Other_____

PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode): 1: (RB / LB / BB / US / DS / ##)

SEDODOR: None, Sulfides, Sewage, Petroleum, Mixed, Other_____ | PRECIPITATION: None, Fog, Drizzle, Rain, Snow | 2: (RB / LB / BB / US / DS / ##)

SEDCOLOR: Colorless, Green, Yellow, Brown | PRECIPITATION (last 24 hrs): Unknown, <1", >1", None

SEDCOMPOSITION: Silt/Clay, FineSand, CoarseSand, Gravel, Cobble, Mixed, HardPanClay | EVIDENCE OF FIRES: No, <1 years, <5 years | 3: (RB / LB / BB / US / DS / ##)

OBSERVED FLOW: NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), 0.1-1cfs, 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs

Samples Taken (# of containers filled) - Method=Sed_Grab | **Field Dup YES / NO:** (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

COLLECTION DEVICE: Scoop (SS / PC / PE, Core (SS / PC / PE), Grab (Van Veen / Eckman / Petite Ponar) | COLLECTION DEVICE AREA (m2): _____

Sample Type:	DepthCollec (cm)	Equipment Used	Sediment Only (Y / N)	PFAS	PBDEs	TOC	Archive PFAS	Archive PBDEs	Archive TOC				
Integrated													
Integrated													
Integrated													
Integrated													

COMMENTS:

Figure 4. Field Datasheet, Sediment Sampling

SWAMP Tissue Sampling - Trawl (Event Type = TI)						Entered in d-base (initial/date)
*StationCode:		*StationName:				*Group:
*FundingCode:		*Date (mm/dd/yyyy): / /				
*Sampling Crew:		ArrivalTime:		WADEABILITY:	YES / NO	BEAUFORT SCALE (1-12):
		DepartureTime:				
Habitat Observations				WIND DIRECTION: N W E S		
SITE ODOR:	None, Sulfides, Sewage, Petroleum, Smoke, Other____			WATERCLARITY:	Clear, Cloudy (>4" vis), Murky (<4" vis)	
SKY CODE:	Clear, Partly Cloudy, Overcast, Fog			WATERODOR:	None, Sulfides, Sewage, Petroleum, Mixed, Other	
OTHER PRESENCE:	Vascular, Nonvascular, OilySheen, Foam, Trash, Other			WATERCOLOR:	Colorless, Green, Yellow, Brown	
DOMINANT SUBSTRATE:	Concrete, Cobble, Gravel, Sand, Mud, Other_____, unk			PRECIPITATION (while sampling):	Unknown, <1", >1", None	
OVERLAND RUNOFF (last 24 hrs):	None, Foggy, Drizzle, Rain, Snow			PRECIPITATION (last 24 hrs):	None, light, moderate/heavy, unknown	
OBSERVED FLOW:	NA, Dry Waterbody Bed, No Observed Flow, Isolated Pool, 0.1 - 1cfs, 1 - 5 cfs, 5 - 20 cfs, 20 - 50 cfs, 50 - 200 cfs, >200cfs					
Tissue Collections				Distance from Bank:		Stream Width (m):
						Water Depth (m):
OCCUPATION METHOD:	Walk-in Bridge R/V _____ Other			*GPS/DGPS	**Latitude**	**Longitude**
COLLECTION METHOD:	Boat (RV _____)			**Target:**		
COLLECTION DEVICE:	Trawl (length & mesh) _____			**Actual:**		
STARTING BANK:	LB / RB / NA (looking downstream)			GPS Model:		
SAMPLE LOCATION:	Bank, Thalweg, Mid-channel, Open Water, NA			Accuracy (ft/m):		
HYDROMODIFICATION LOCATION	US / DS / NA/ WithIn (relative to sample location)			Datum: NAD83 WGS84 Other _____		
HYDROMODIFICATION:	None, Bridge, Pipes, Concrete Channel, Grade Control, Culvert, Other _____					

Cast	Start Time	Latitude	Longitude	End Time	Latitude	Longitude
1						
2						
3						
4						
5						
Total Number of Clams:						
Comments:						

Figure 5. Field Datasheets, Clam Sampling (p. 1 of 3)

SWAMP Tissue Sampling - Bivalve Collections							Entered in d-base (initial/date)
StationCode:				StationName:		Date: / /	
Location #	**COMPOSITE ID**	**Sample #**	**Species Name/Code**	**Life Stage**	**Shell Length (mm)**	**Shell Width (mm)**	**Weight (g)**
		–1	Corbicula fluminea	A J SA NR			
		–2	Corbicula fluminea	A J SA NR			
		–3	Corbicula fluminea	A J SA NR			
		–4	Corbicula fluminea	A J SA NR			
		–5	Corbicula fluminea	A J SA NR			
		–6	Corbicula fluminea	A J SA NR			
		–7	Corbicula fluminea	A J SA NR			
		–8	Corbicula fluminea	A J SA NR			
		–9	Corbicula fluminea	A J SA NR			
		–10	Corbicula fluminea	A J SA NR			
		–11	Corbicula fluminea	A J SA NR			
		–12	Corbicula fluminea	A J SA NR			
		–13	Corbicula fluminea	A J SA NR			
		–14	Corbicula fluminea	A J SA NR			
		–15	Corbicula fluminea	A J SA NR			
		–16	Corbicula fluminea	A J SA NR			
		–17	Corbicula fluminea	A J SA NR			
		–18	Corbicula fluminea	A J SA NR			
		–19	Corbicula fluminea	A J SA NR			
		–20	Corbicula fluminea	A J SA NR			
Location #: Match with tissue collection sheet **(= 1 unless target moved)**				**COMPOSITE ID:** Match with sample labels			
Species Corbicula fluminea				**Format: "DRMP-CEC-SITECODE-YYYY-MM-DD"**			
Stage: Adult (A), Juvenile (J), Subadult (SA), Not Recorded (NR)							
Comments: **USE LABELS 1-20 TO IDENTIFY EACH INDIVIDUAL; USE COMPOSITE ID LABELS TO IDENTIFY EACH SAMPLE; USE ADDITIONAL PAGES FOR COMPOSITES >20 UNITS**							

Figure 6. Field Datasheets, Clam Sampling (p. 2 of 3)

SWAMP Tissue Sampling - Bivalve Collections						Entered in d-base (initial/da	
StationCode:			StationName:		Date: / /		
	Bin Size (mm)	#	Est. mass / bin	Est. mass / bin	Extra allocation	Extra mass	Total
	10 to 15		0.1	0		0	0
	15 to 20		0.4	0		0	0
	20 to 25		1.5	0		0	0
	25 to 30		1.8	0		0	0
	>30		2	0		0	0
	Total	0		0		0	0
Comments							

Figure 7. Field Datasheets, Clam Sampling (p. 3 of 3)

Meter Calibration Form for Delta RMP CEC Monitoring

Model _____

CEDEN ID _____

Date	Time	Initials	pH Calibration						Dissolved Oxygen Calibration			
			pH 4 (pre)	pH 4 (post)	pH 7 (pre)	pH 7 (post)	pH 10 (pre)	pH 10 (post)	DO (pre)	DO (post)	Temp (˚C)	DO Gain
Comments												

Date	Time	Initials	Turbidity Calibration			Specific Conductivity		
			Turbidity @ 0 NTU (pre)	Turbidity @ 0 NTU (post)	Turbidity @ 124 NTU (pre)	Turbidity @ 124 NTU(post)	Sp Cond 1413 µS/cm (pre)	Sp Cond 1413 µS/cm (post)
Comments								

Figure 8. Water Quality Meter Calibration Log

7. Appendix B – Chain of Custody Forms

MLJ ENVIRONMENTAL

AXYS CHAIN-OF-CUSTODY RECORD

Client Name:	MLJ Environmental
Address:	1480 Drew Ave #130, Davis, CA 95618
Sampled By:	
Phone:	(530) 756-5200
Fax:	(530) 756-5225
Project Manager:	Melissa Turner
Project Name:	Delta RMP CEC

	Sample Identification	Sample Date	Sample Time	Sample Matrix	Number	Type	Preservative	PBDE 47 (SGS AXYS MLA-033 Rev 06)	PBDE 99 (SGS AXYS MLA-033 Rev 06)	PBDE suite by Method SGS AXYS MLA-033 Rev 06	Immediately freeze all samples to -20°C SAMPLE COMMENTS
1				Sediment	2	8oz Amber Glass Jar	Ice	X	X	X	
2											
3											
4											
5											
6											
7											
8											

Comments:	Relinquished By	Relinquished By
Please fax signed and completed COC to MLJ Environmental: (530) 756-5225, or email to mbundock@mljenvironmental.com	Signature	Signature
	Print Name	Print Name
	Organization	Organization
	Date Time	Date Time
Immediately freeze all samples to -20°C when received.	**Received By**	**Received By**
	Signature	Signature
	Print Name	Print Name
	Organization	Organization
	Date Time	Date Time
	Temperature when received (°C):	Temperature when received (°C):

Figure 9. Example Chain of Custody form.